Australian Government
Department of the Environment and Energy

Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2018

Incorporating emissions from the NEM up to March 2019

Australia's National Greenhouse Accounts

Preface

The *Quarterly Update* reports on the latest estimates of Australia's National Greenhouse Gas Inventory. This update provides estimates of Australia's national inventory of greenhouse gas emissions up to the December quarter of 2018, and emissions from the National Electricity Market (NEM)[1] up to the March quarter 2019.

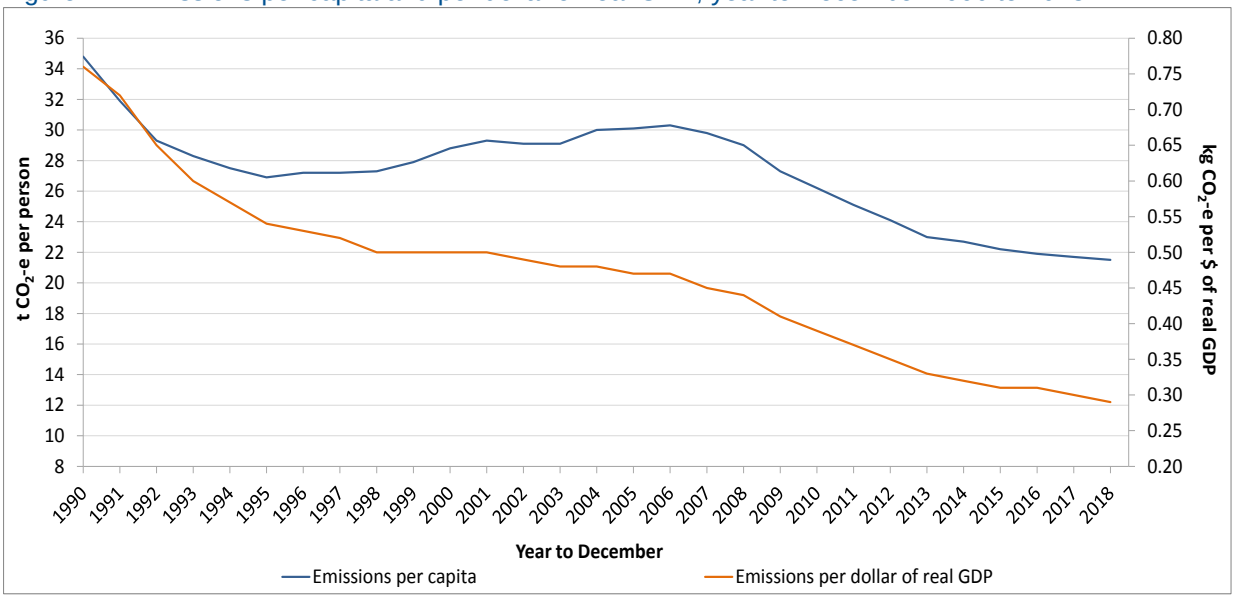
National emission levels[2] for the December quarter 2018 increased by 0.8 per cent relative to the previous quarter, on a seasonally adjusted and weather normalised basis, primarily due to increased emissions from LNG for export, diesel consumption across transport, and metal manufacturing. In trend terms, emissions have also increased by 0.2 per cent.

Emissions for the year to December 2018 are estimated to be 538.2 Mt CO_2-e, up 0.7 per cent (3.5 Mt CO_2-e) on the previous year, primarily due to increased LNG exports (22.2 per cent).

Australia's emissions for the year to December 2018 have declined 14.2 per cent since the peak in the year to June 2007 and were 0.4 per cent above emissions in 2000 and 11.9 per cent below emissions in 2005.

Emissions per capita, and the emissions intensity of the economy, were at their lowest levels in 29 years. Emissions per capita in the year to December 2018 have fallen 38.2 per cent since 1990, while the emissions intensity of the economy has fallen 61.4 per cent (Figure P1).

Figure P1: Emissions per capita and per dollar of real GDP, year to December 1990 to 2018



Source: Department of the Environment and Energy

Electricity sector emissions decreased by 3.5 per cent in the year to December 2018 and 15.5 per cent from the peak recorded in the year to June 2009.

Annual emissions from the NEM for the year to March 2019 decreased 2.1 per cent on the previous year. Emissions from the NEM for the March 2019 quarter increased by 1.8 per cent on a seasonally adjusted and weather normalised basis[3], and were unchanged at 0.0 per cent in trend terms.

[1] The NEM includes grid electricity in the Eastern and South Eastern states and accounts for approximately 85 per cent of total *electricity* estimates in the year to December 2018.

[2] National emissions level are inclusive of all sectors of the economy, including *Land Use, Land use Change and Forestry* (LULUCF).

[3] 'Unadjusted', 'seasonally adjusted, weather normalised' and 'trend' are defined in Section 5: *Technical notes*

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1. Overview

Table 1: National Greenhouse Gas Inventory[4], December quarter 2018, emissions growth rates

	December quarter 2018	Year to December 2018
Quarterly change – seasonally adjusted and weather normalised[5]	0.8%	
Quarterly change – seasonally adjusted and weather normalised – trend[2]	0.2%	
Annual Change		0.7%

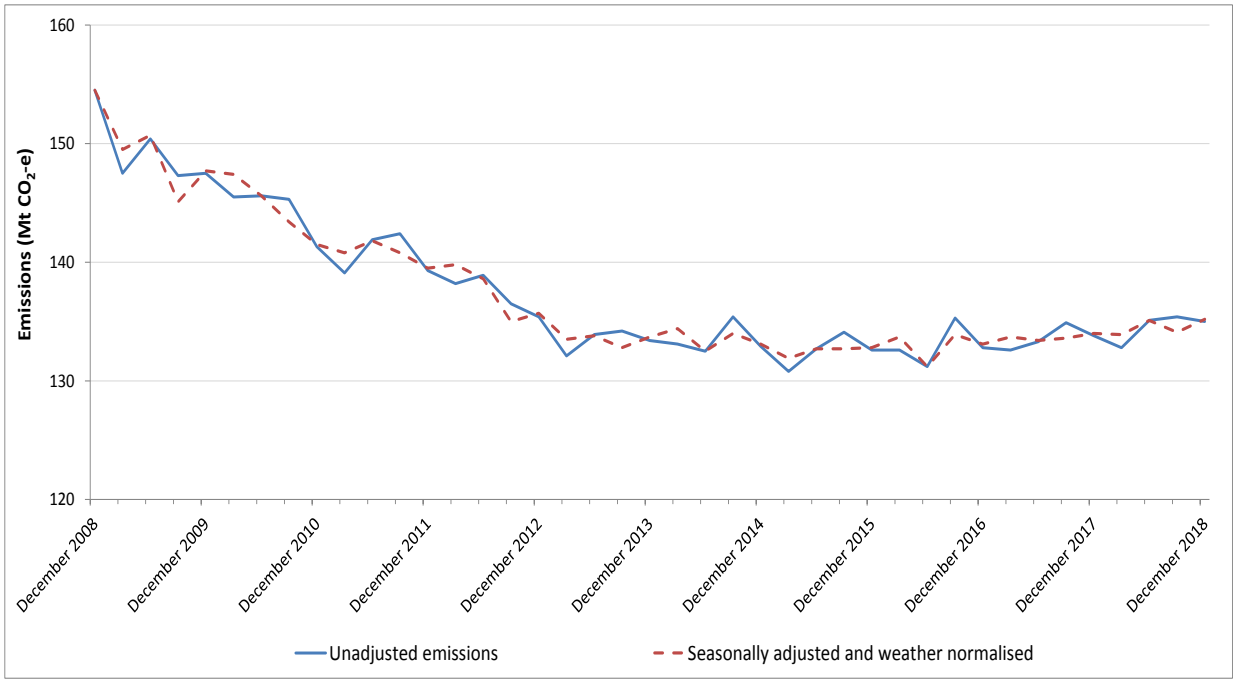
Table 2: National Electricity Market (NEM)[6], March quarter 2019, emissions growth rates

	March quarter 2019	Year to March 2019
Quarterly change – seasonally adjusted and weather normalised[2]	1.8%	
Quarterly change – seasonally adjusted and weather normalised – trend[2]	0.0%	
Annual Change		-2.1%

Summary of emissions in the December quarter 2018

In the December quarter of 2018, seasonally adjusted emissions increased by 0.8 per cent (Figure 1 and Figure 2).

Figure 1: Emissions[2], by quarter, December 2008 to December 2018



Source: Department of the Environment and Energy

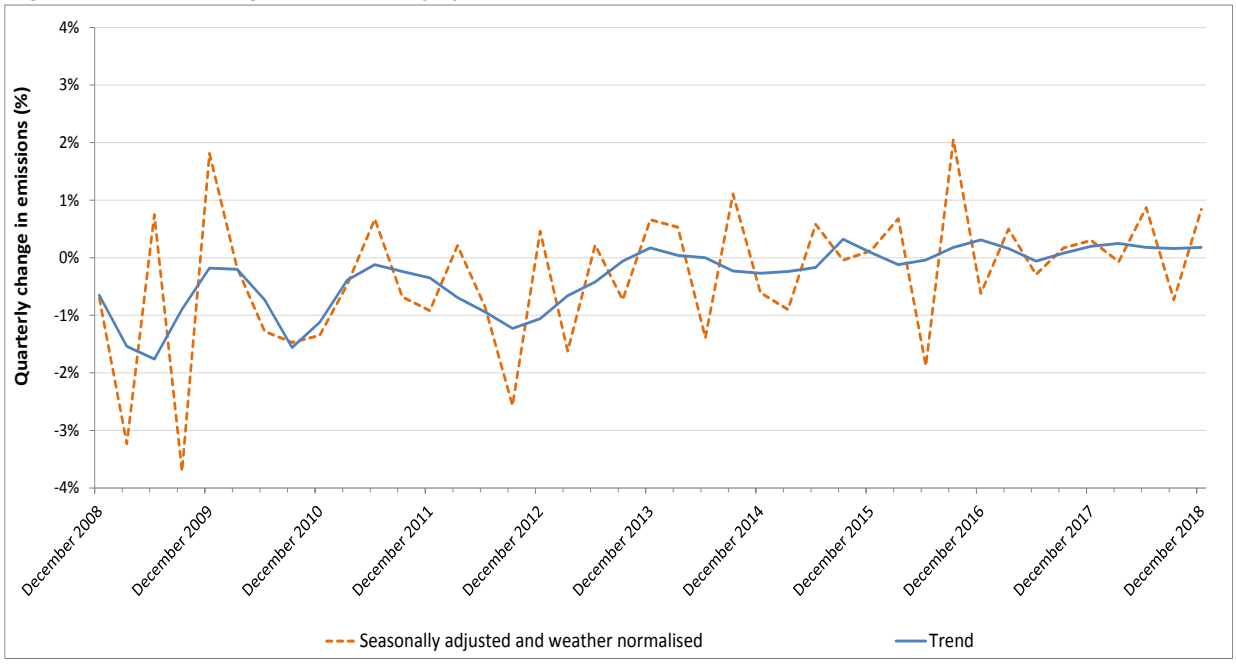
[4] National emissions level are inclusive of all sectors of the economy, including *Land Use, Land use Change and Forestry* (LULUCF).

[5] 'Unadjusted', 'seasonally adjusted, weather normalised' and 'trend' are defined in Section 5: *Technical notes*

[6] The NEM includes grid electricity in the Eastern and South Eastern states and accounts for approximately 85 per cent of total *electricity* estimates in the year to December 2018.

This is driven in part by seasonally adjusted increases in emissions from fugitives (9.9 per cent), stationary energy (0.7 per cent) and transport (0.4 per cent). These increases reflect growth in LNG for export (22.2 per cent), diesel consumption across transport (1.4 per cent), and metal manufacturing (iron and steel production up 10.6 per cent and aluminium production up 5.8 per cent).

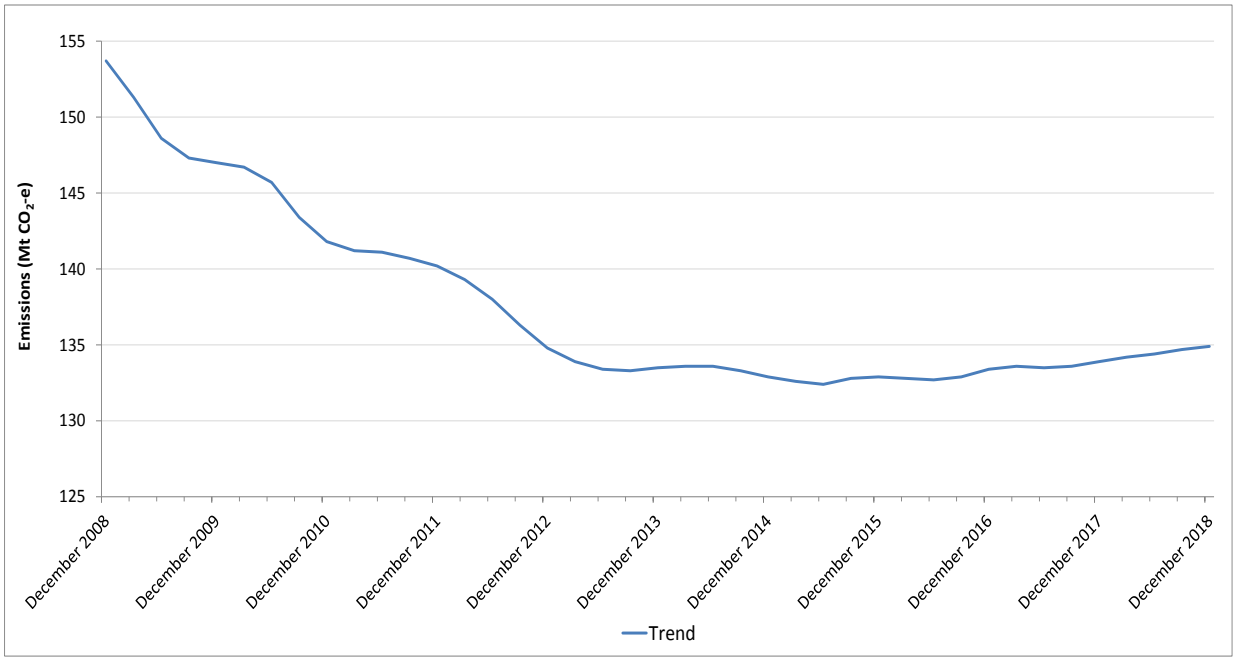
Figure 2: Emissions growth rates, by quarter, December 2008 to December 2018



Source: Department of the Environment and Energy

Trend emissions (Figure 3) increased by 0.2 per cent, reflecting increases in emissions from *stationary energy*, *fugitive* emissions and *waste*.

Figure 3: Trend emissions, by quarter, December 2008 to December 2018



Source: Department of the Environment and Energy

Summary of annual emissions

Annual emissions for the year to December 2018 are estimated to be 538.2 Mt CO_2-e.

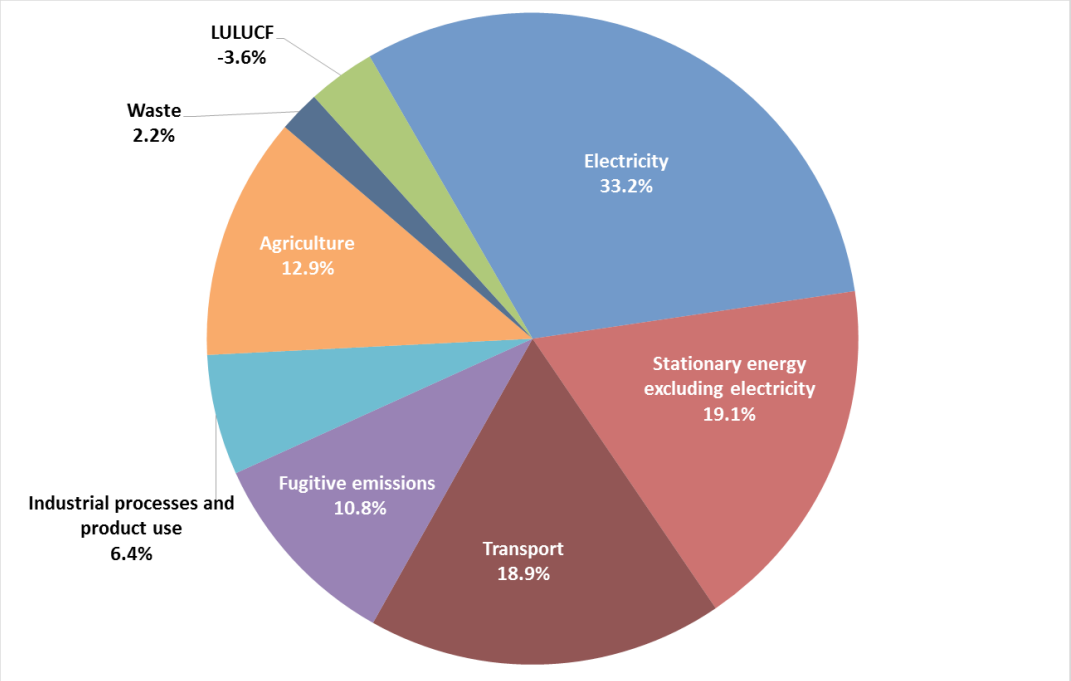
The 0.7 per cent or 3.5 Mt CO_2-e increase in emissions over the year to December, reflects increases in emissions from the *stationary energy*, *transport*, *fugitive*, *industrial processes and product use* and *waste* sectors (Table 3). These increases in emissions were partially offset by decreases in emissions from *agriculture* and the *electricity* sectors.

Table 3: 'Unadjusted' annual emissions, by sector, for the year to December 2017 and 2018

Sector	Annual emissions (Mt CO_2-e)		Change (%)
	Year to December 2017	Year to December 2018	
Energy – Electricity	185.5	178.9	-3.5
Energy – Stationary energy excluding electricity	97.0	102.8	6.0
Energy – Transport	99.0	101.7	2.8
Energy – Fugitive emissions	55.4	58.1	4.9
Industrial processes and product use	33.7	34.7	2.9
Agriculture	71.7	69.4	-3.3
Waste	11.9	12.1	1.7
Land Use, Land Use Change and Forestry	-19.5	-19.5	0.4[a]
National Inventory Total	**534.7**[b]	**538.2**[b]	**0.7**[b]

[a]actual change is a small increase in net emissions of less than 0.1 Mt CO_2- e
[b]all values are rounded, total is derived from full precision data

Figure 4: Emissions contribution, by sector, for the year to December 2018



Source: Department of the Environment and Energy

The increases in *stationary energy* emissions reflect strong growth over the year in LNG exports (up 22.2 per cent), steel production (up 10.6 per cent) and aluminium production (up 5.8 per cent). Growth in LNG also strongly impacted *fugitive* emissions due to flaring and the venting of methane and carbon dioxide. The increase of 10.6 per cent in steel production in particular affected *industrial processes and product use* emissions.

Transport emissions also increased 2.8 per cent over the year to December, reflecting a 10.9 per cent increase in diesel consumption.

Over the year to December 2018, there were decreases in emissions from the *electricity* and *agriculture* sectors. The 3.5 per cent decrease in emissions from the *electricity* sector are due to a 6.0 per cent reduction in brown coal supply, a 26.6 per cent reduction in gas supply, and a corresponding 31.1 per cent increase in supply from renewable sources. The 3.3 per cent decline in emissions from the *agriculture* sector reflects a decrease in emissions from enteric fermentation, which is largely driven by a decline in the beef cattle population[7].

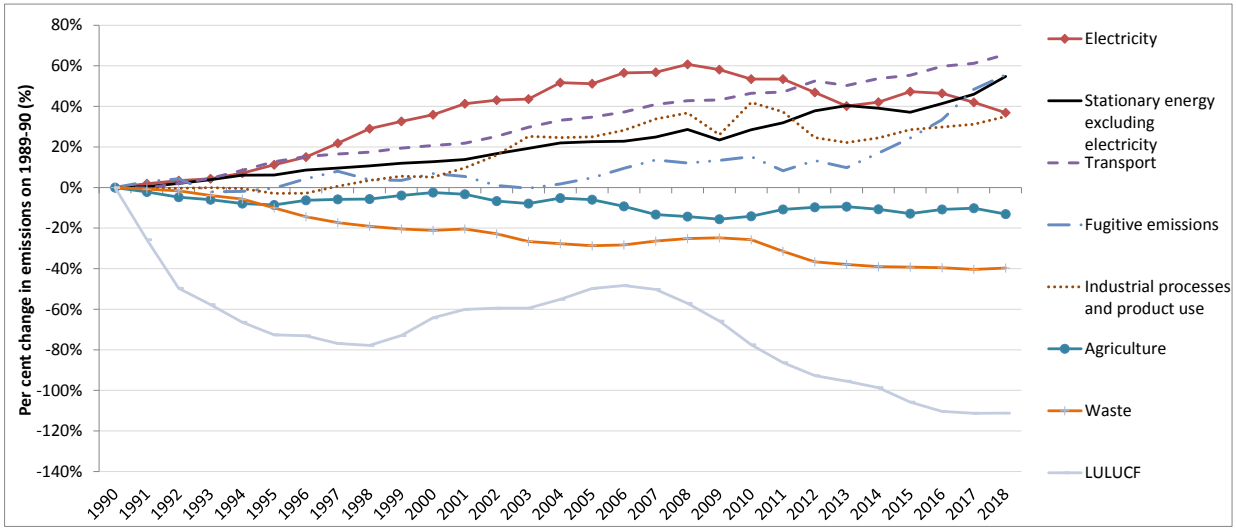
Sectoral trends since 1990

Australia's emissions have decreased by 9.5 per cent (56.2 Mt CO_2-e) since 1990, reaching 538.2 Mt CO_2-e in the year to December 2018.

The *electricity* sector has experienced the largest growth, increasing by 48.2 Mt CO_2-e between 1990 and the year to December 2018. Other sectors which have increased in emissions since 1990 include *stationary energy excluding electricity*, *transport*, *fugitive emissions* and *industrial processes and product use*. In contrast, the *waste* and *agriculture* sectors have each decreased in emissions since 1990. *Land Use, Land Use Change and Forestry (LULUCF)* emissions have decreased by the largest margin of any sector since 1990 (192.5 Mt CO_2-e).

The change in emissions from each sector from the year to December 1990 to 2018 in Mt CO_2-e in percentage terms is presented in Figure 5.

Figure 5: Percentage change in emissions, by sector, since year to December 1990



Source: Department of the Environment and Energy

[7] Australian Bureau of Agricultural and Resource Economics and Sciences (2019). *Agricultural Commodities, March Quarter 2019*.

2. Sectoral Analysis

2.1 Energy – Electricity

Electricity generation is the largest source of emissions in the national inventory, accounting for 33.2 per cent of emissions in the year to December 2018 (Figure 4).

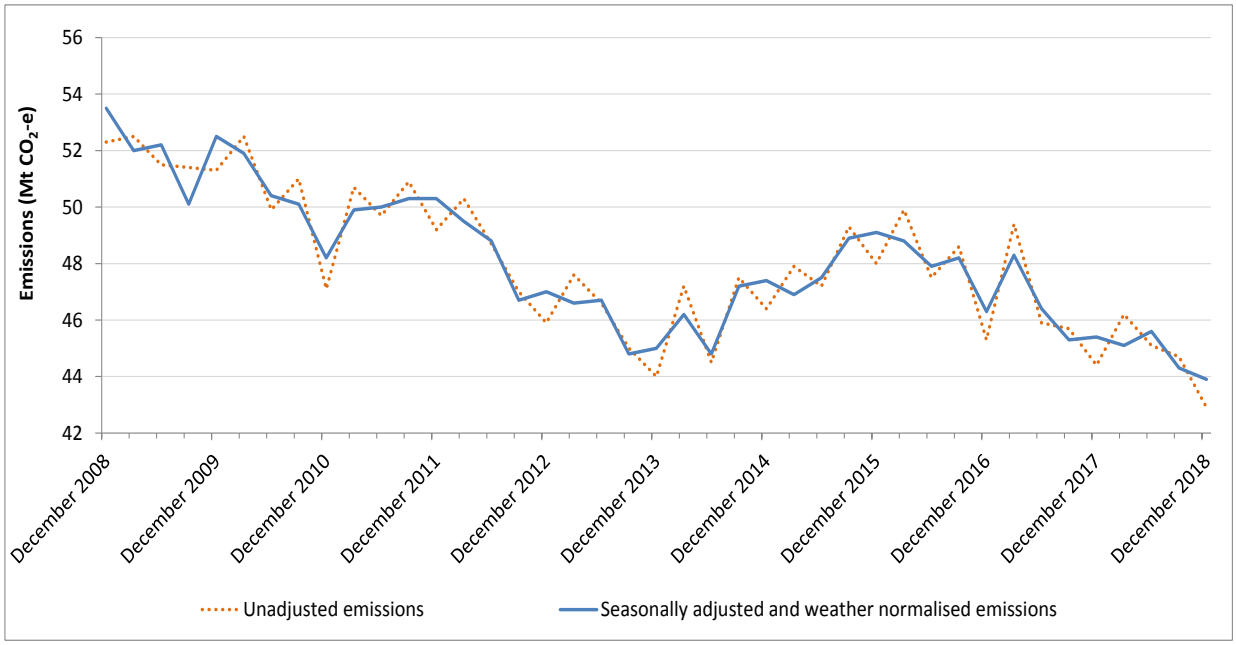
Electricity sector emissions have declined by 15.5 per cent (32.8 Mt CO_2-e) in the year to December 2018, from the peak recorded in the year to June 2009 (Data Table 1A).

'Unadjusted' emissions from *electricity* generation decreased by 4.0 per cent in the December quarter of 2018 compared to the September quarter of 2018 (Figure 6).

On a 'seasonally adjusted and weather normalised'[8] basis emissions decreased 0.9 per cent reflecting a strong increase in solar generation in the NEM (50.9 per cent) and decreases in gas and brown coal generation (15.7 and 9.9 per cent).

Trend emissions decreased 1.3 per cent in the December quarter of 2018 compared to the September quarter of 2018.

Figure 6: *Electricity* sector emissions, by quarter, December 2008 to December 2018



Source: Department of the Environment and Energy

Over the year to December 2018, emissions from *electricity* decreased by 3.5 per cent on the previous year.

In the year to March 2019, emissions from the NEM decreased 2.1 per cent compared with the year to March 2018 (Figure 7). Emissions from the NEM account for around 85 per cent of national electricity emissions.

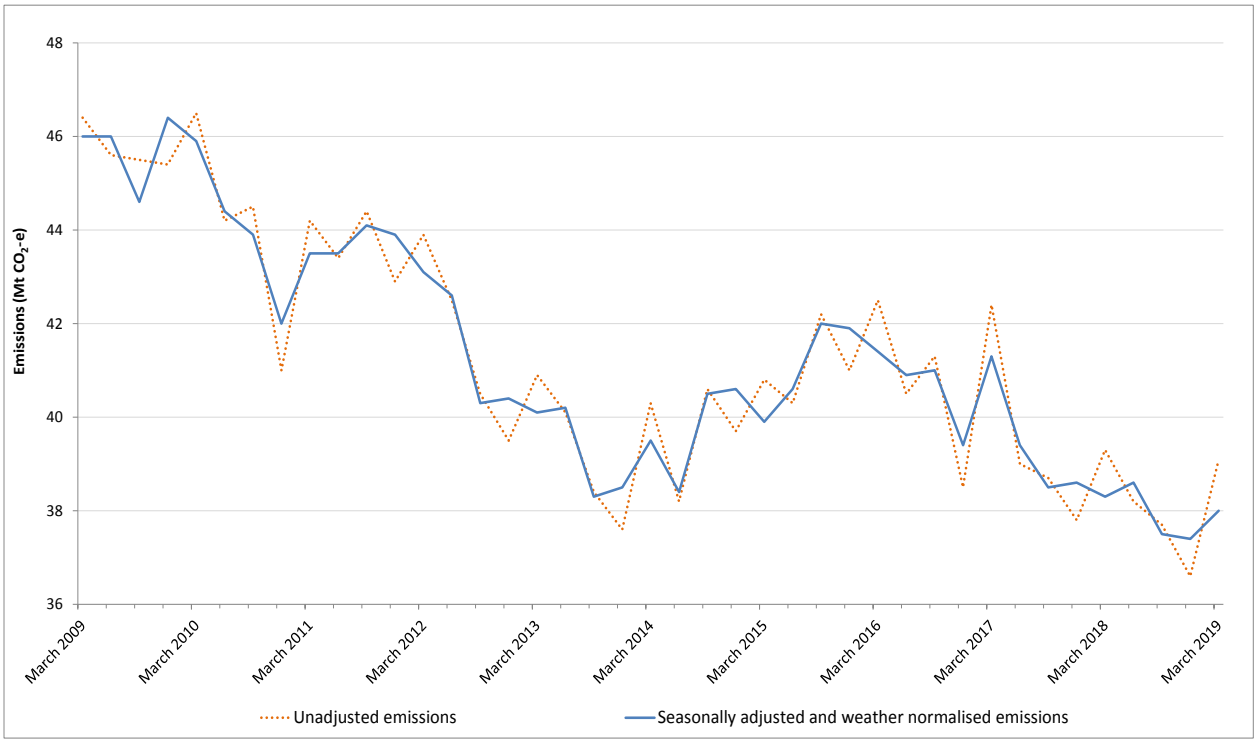
[8] Two adjustments are made:

a) Seasonal adjustment is a first-order adjustment using ABS software that systematically corrects emissions data for average fluctuations in seasonal conditions which, for example, controls for the effects of two seasonal peaks in electricity demand. One in winter (associated with demand for heating) and one in summer (associated with demand for cooling); and

b) Weather normalisation is a second-order adjustment that systematically corrects emissions data for atypical temperature effects on electricity demand within the year which, for example, controls for the effects of unusually cold winters or unusually hot summers.

The weather normalisation methodology is described in detail in 'Section 7: Special Topic' of the December 2011 *Quarterly Update*.

Figure 7: NEM *electricity* emissions, by quarter, March 2009 to March 2019

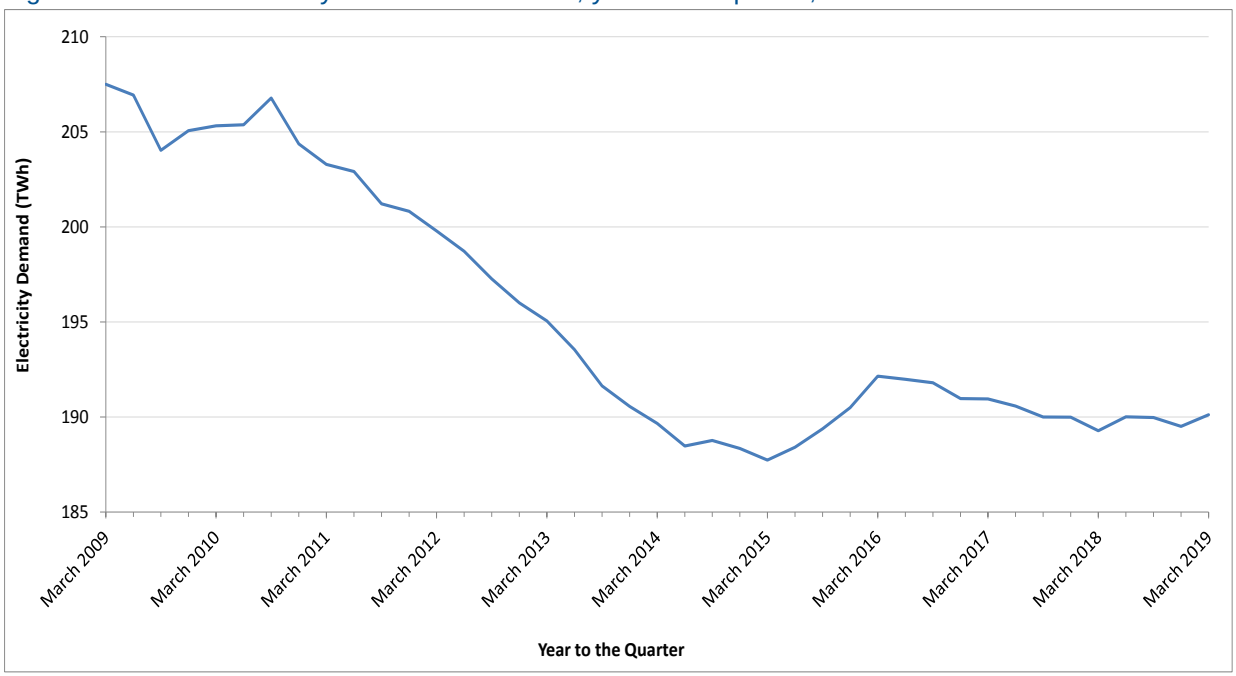


Source: Department of the Environment and Energy

Emissions for the March quarter 2019 increased by 1.8 per cent on a seasonally adjusted and weather normalised basis.

Demand in the NEM in the year to March 2019 remained flat at 0.0 per cent (Figure 8).

Figure 8: Metered electricity demand in the NEM, year to the quarter, March 2009 to March 2019[9]

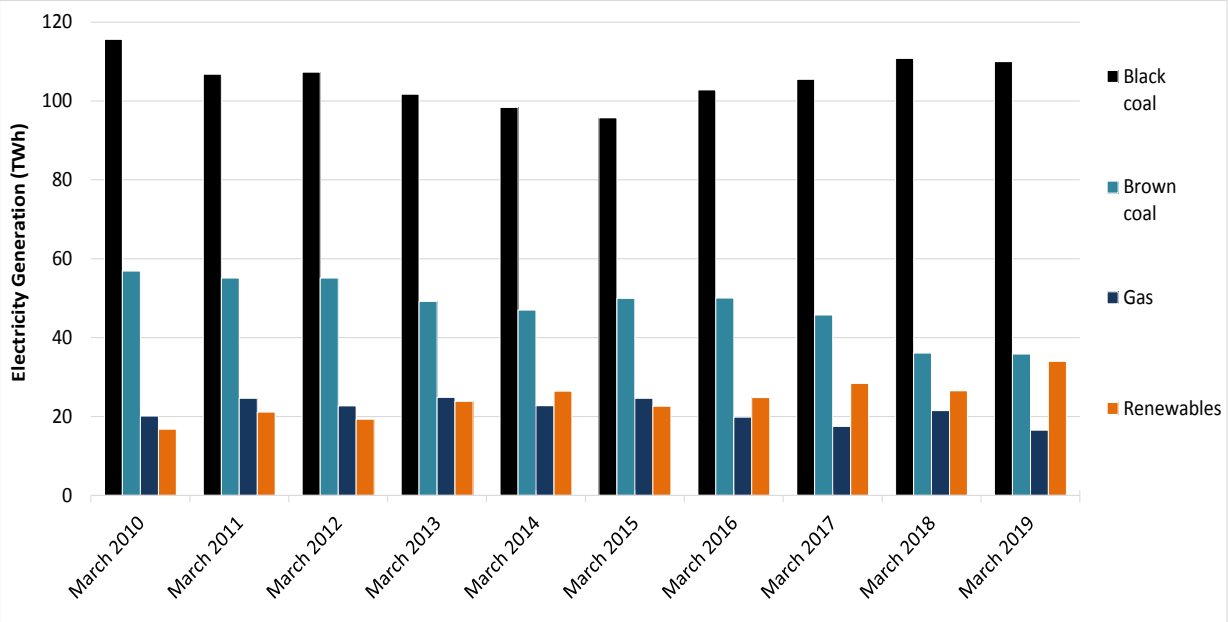


Source: Australian Energy Market Operator (AEMO, 2018), obtained using NEM-Review software

[9] The data presented in Figure 8 represents demand for the year to the quarter in the x-axis. For example, December 2016 correlates to demand from 1 January 2016 to 31 December 2016 and September 2016 correlates to demand from 1 October 2015 to 30 September 2016.

Reduced emissions in the year to March 2019 are principally a result of increased renewable generation (28.0 per cent) in the NEM and reductions of 0.8 per cent in black coal generation, 0.7 per cent in brown coal generation and 23.1 per cent in gas generation (Figure 9).

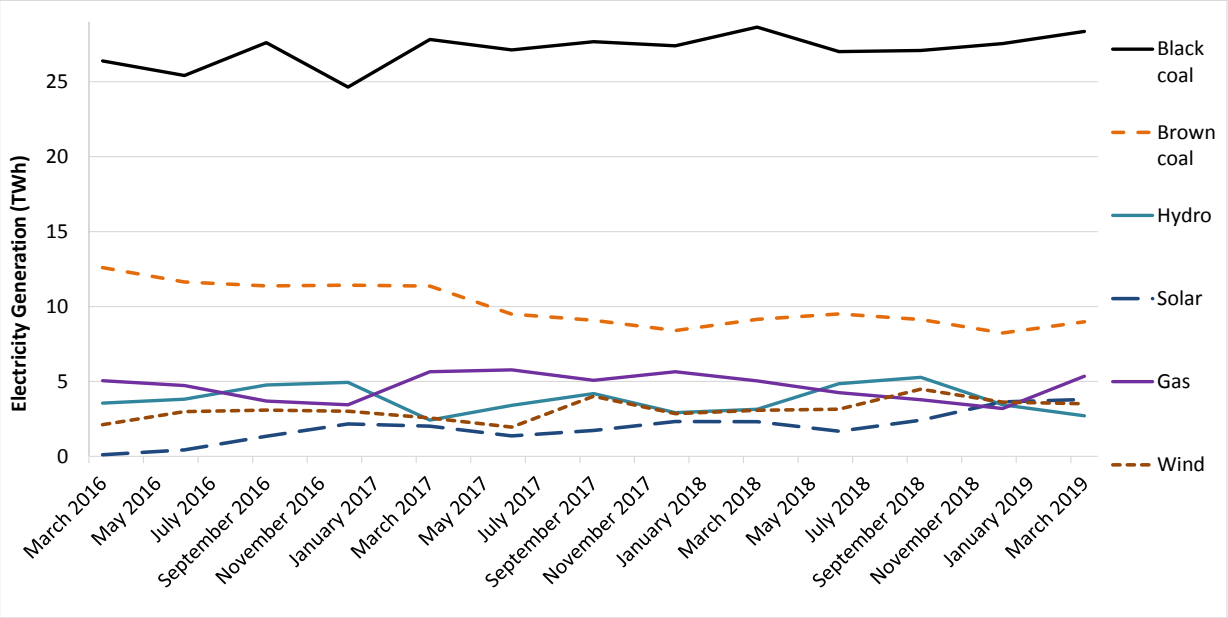
Figure 9: *Electricity* generation in the NEM, by fuel, year to March 2010 to March 2019



Source: Australian Energy Market Operator

Changes in the fuel mix used to generate electricity in the NEM over the past ten years are presented in Figure 9. Since the year to March 2010, coal generation has decreased from 82.0 per cent of total generation to 74.0 per cent. Gas generation has decreased from 10.0 per cent to 8.0 per cent and renewable generation (predominantly wind and solar generation) has increased from 8.0 per cent to 17.0 per cent of total generation.

Figure 10: *Electricity* generation in the NEM, by fuel, by quarter, March 2016 to March 2019



Source: Department of the Environment and Energy

For the March 2019 quarter, generation from renewables decreased 6.4 per cent, in contrast to the 12.0 per cent decrease for the December 2018 quarter (Figure 9). This was primarily due to decreases in wind generation (down 3.1 per cent) and hydro generation (down 21.4 per cent) in the NEM.

The shortfall in the NEM created by the decrease in renewable generation, in conjunction with an increase in demand for the March quarter (up 0.3 per cent), was met by increases in electricity generation from black coal (2.9 per cent), brown coal (9.1 per cent) and gas (67.9 per cent) (Figure 10). These increases in the March quarter were in contrast to the decreases of 1.2 per cent for coal and 15.7 per cent for gas, recorded in the December 2018 quarter.These changes in the fuel mix during the March quarter contributed to an increase of 1.8 per cent in emissions from the *electricity* sector on a seasonally adjusted and weather normalised basis (Figure 7).

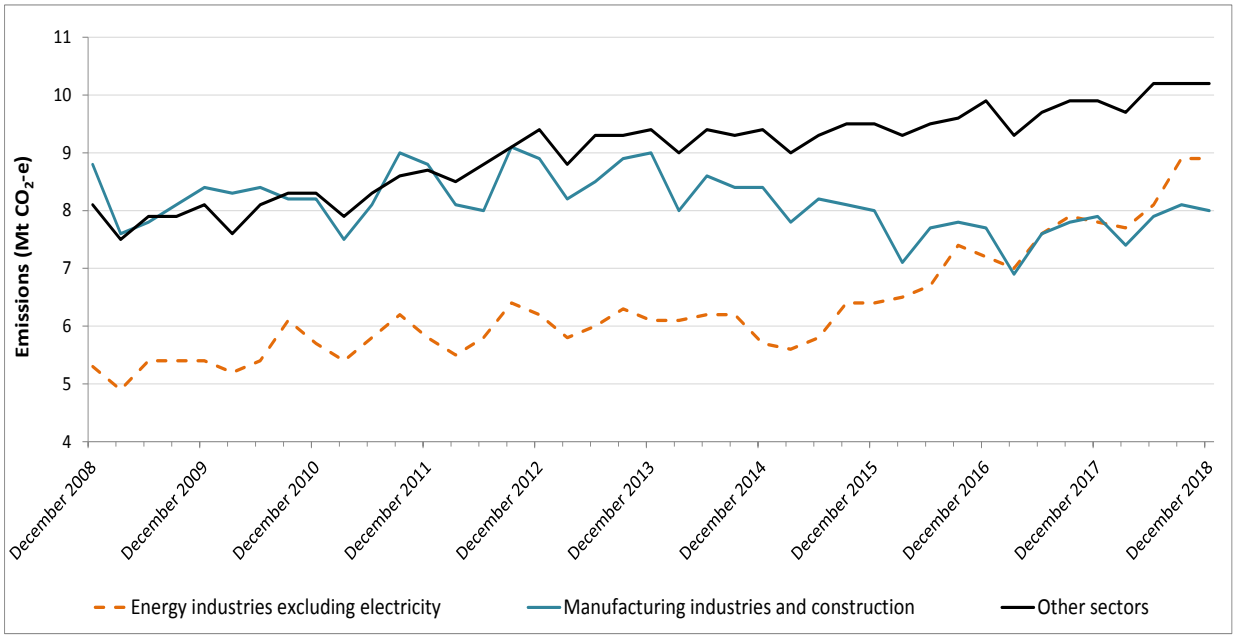
2.2 Energy – Stationary energy excluding electricity

Stationary energy excluding electricity includes emissions from direct combustion of fuels, predominantly from the manufacturing, mining, residential and commercial sectors. The mining sector includes petroleum, coal, crude oil, and gas.

In the year to December 2018, *stationary energy excluding electricity* accounted for 19.1 per cent of Australia's national inventory (Figure 4).

Emissions from *stationary energy excluding electricity* in the December quarter of 2018 increased 0.8 per cent in trend terms compared with the September quarter of 2018. Emissions over the year to December 2018, increased by 5.7 per cent when compared with the previous year.

Figure 11: *Stationary energy excluding electricity* emissions, unadjusted, by sub-sector, by quarter, December 2008 to December 2018

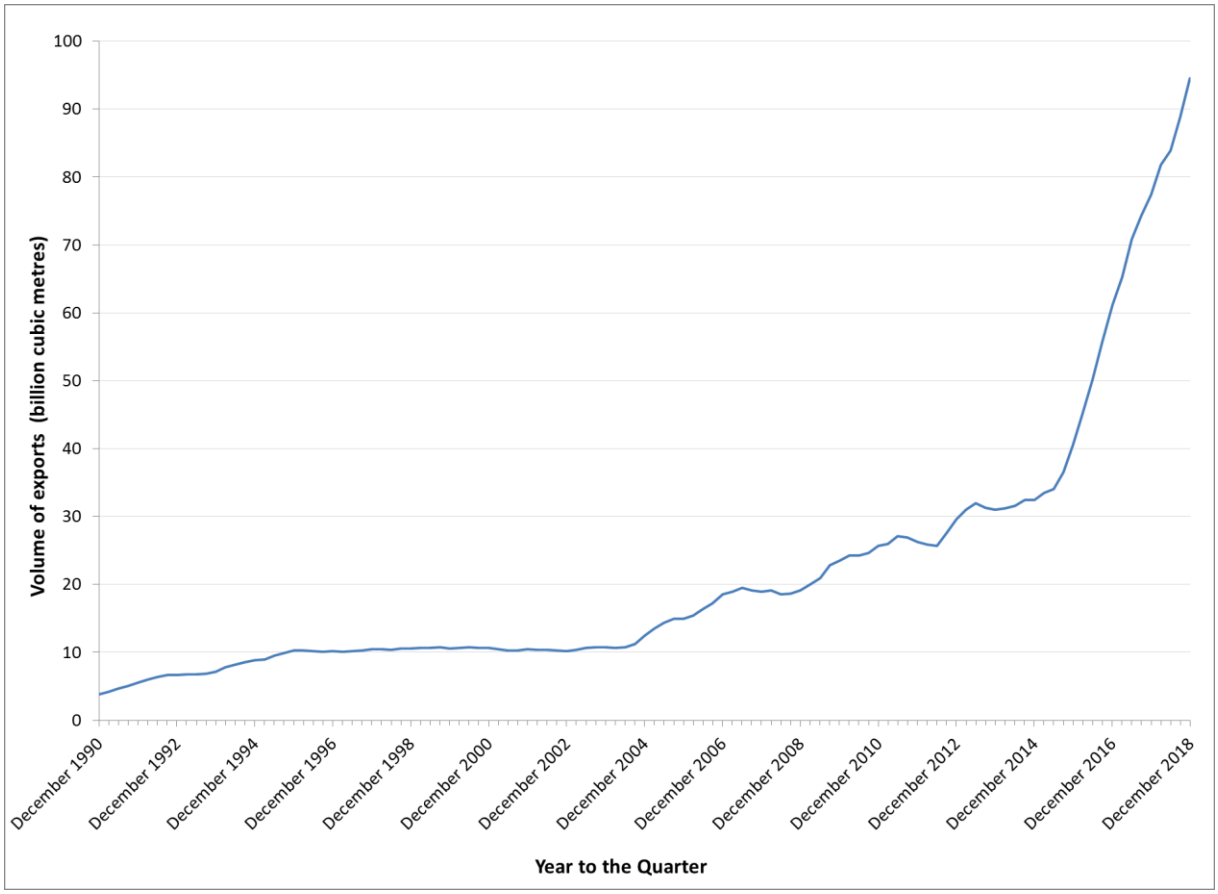


Source: Department of the Environment and Energy

The emissions per quarter for *stationary energy excluding electricity* are presented in Figure 11.

Emissions from energy industries excluding electricity increased emissions by 5.8 Mt CO_2-e in the year to December 2018 compared with the year to December 2017. This was driven primarily by an increase of 22.2 per cent in LNG exports in the year to December 2018 (Figure 12).

Figure 12: LNG exports, year to the quarter, December 1990 to December 2018



Source: Department of Industry, Innovation and Science (2019), Resources and Energy Quarterly

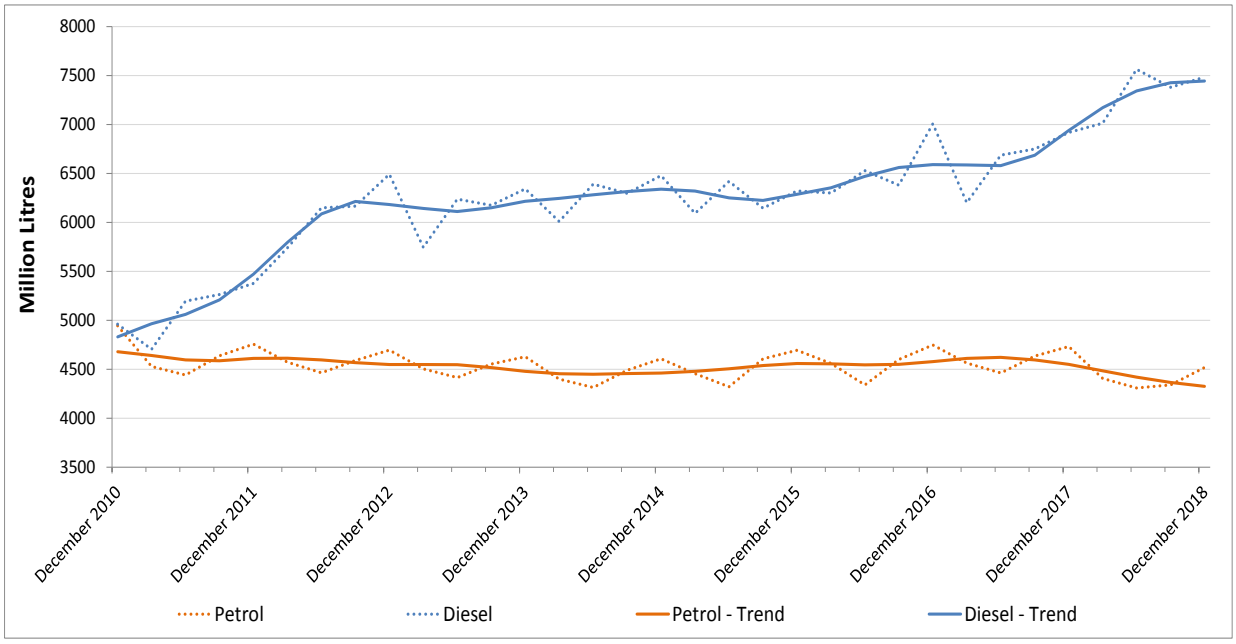
2.3 Energy – Transport

The *transport* sector includes emissions from the direct combustion of fuels in transportation by road, rail, domestic aviation and domestic shipping. The main fuels used for transport are automotive gasoline (petrol), diesel oil, liquefied petroleum gas (LPG) and aviation turbine fuel.

In the year to December 2018, transport accounted for 18.9 per cent of Australia's national inventory (Figure 4).

Emissions from *transport* over the year to December 2018 increased by 2.8 per cent when compared with the previous year. The growth in transport was reflected in a 10.9 per cent annual growth in diesel consumption for the year to December 2018. This is attributed to increased diesel passenger vehicle sales and freight activity, supported by steady economic and population growth, and switching to diesel vehicles (associated with a 4.5 per cent fall in annual petrol consumption for the year to December 2018) (Figure 13).

Figure 13: Consumption of primary liquid fuels, unadjusted and trend, by sub-sector, by quarter, December 2010 to December 2018



Source: Department of the Environment and Energy (2018), Australian Petroleum Statistics

Annual consumption of the major liquid fuels is presented in Figure 13 and is a general indicator of emissions from the domestic transport sector. This shows a large increase in diesel consumption around 2012, driven by increases in resource mining production. Fuel switching as a result of consumer preferences for diesel vehicles has particularly increased since the June 2017 quarter.

Emissions in the December 2018 quarter decreased 0.6 per cent in trend terms, while 'unadjusted' emissions increased 2.2 per cent. This is the delayed result of lower than usual diesel sales for the September quarter (Figure 14). A return to trend growth is however expected in the future, as a result of strong diesel sales growth in the December 2018 quarter. This increase reflects the return to long term diesel consumption growth for road and rail transportation from the slowdown in the September 2018 quarter.

Figure 14: *Transport* emissions, unadjusted and trend, by quarter, December 2008 to December 2018

Source: Department of the Environment and Energy

The domestic transport sector accounts for over 70 per cent[10] of liquid fuels consumed in Australia. The past six years have seen a decrease in the consumption of petrol (including ethanol-blended) of 4.1 per cent and a strong increase in diesel consumption of 19.9 per cent.

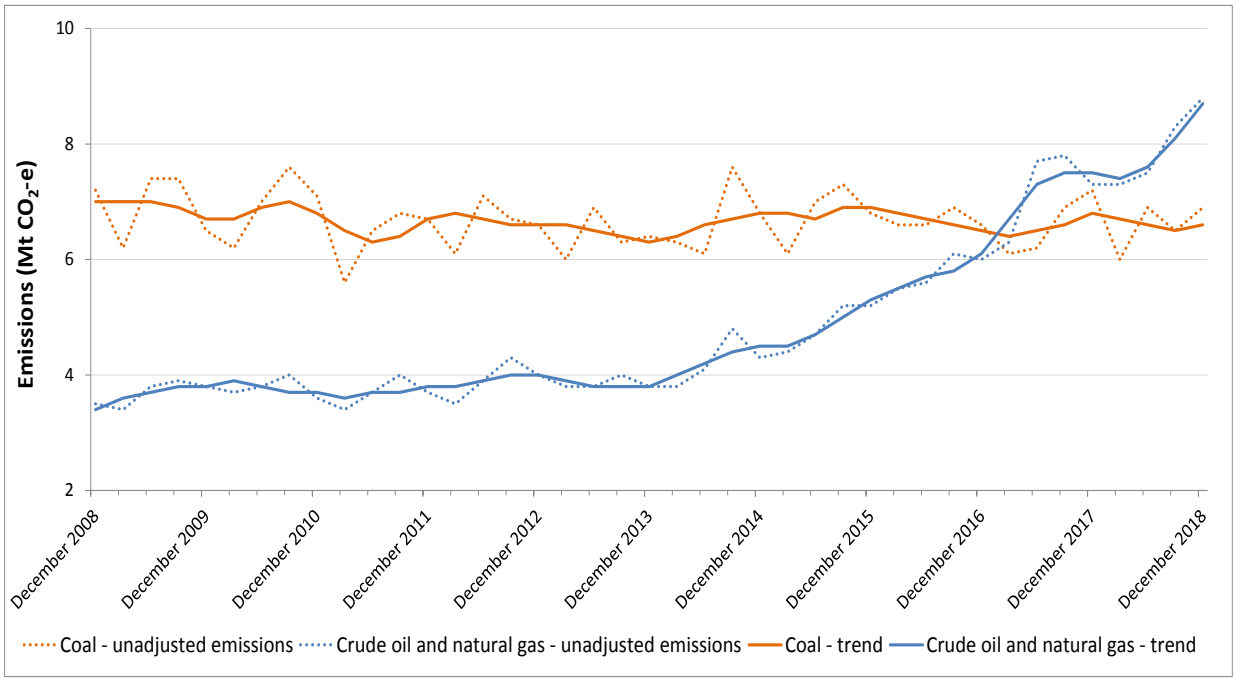
[10] Department of Industry and Science (2018). Australian Energy Statistics: Table F. http://www.industry.gov.au/industry/Office-of-the-Chief-Economist/Publications/Pages/Australian-energy-statistics.aspx

2.4 Energy – Fugitive emissions

Fugitive emissions occur during the production, processing, transport, storage, transmission and distribution of fossil fuels. These include coal, crude oil and natural gas production and processing. Emissions from decommissioned underground coal mines are also included in this sector.

In the year to December 2018, *fugitive emissions* accounted for 10.8 per cent of Australia's national inventory (Figure 4).

Figure 15: *Fugitive emissions*, unadjusted and trend, by sub-sector, by quarter December 2008 to December 2018



Source: Department of the Environment and Energy

Fugitive emissions in the December quarter increased 9.9 per cent on a seasonally adjusted basis. Emissions increased in trend terms by 3.8 per cent.

The increase in emissions is driven by total gas production increasing 7.1 per cent in the December 2018 quarter. This includes a 6.5 per cent increase in LNG exports. An 11.8 per cent increase in underground coal production also contributed to the increase in *fugitive* emissions.

Annual unadjusted emissions in this sector increased by 4.9 per cent over the year to December 2018 (Figure 15). This increase in *fugitive* emissions was driven by an increase of 15.1 per cent in natural gas production[11], and a 0.5 per cent annual increase in coal production.[11]

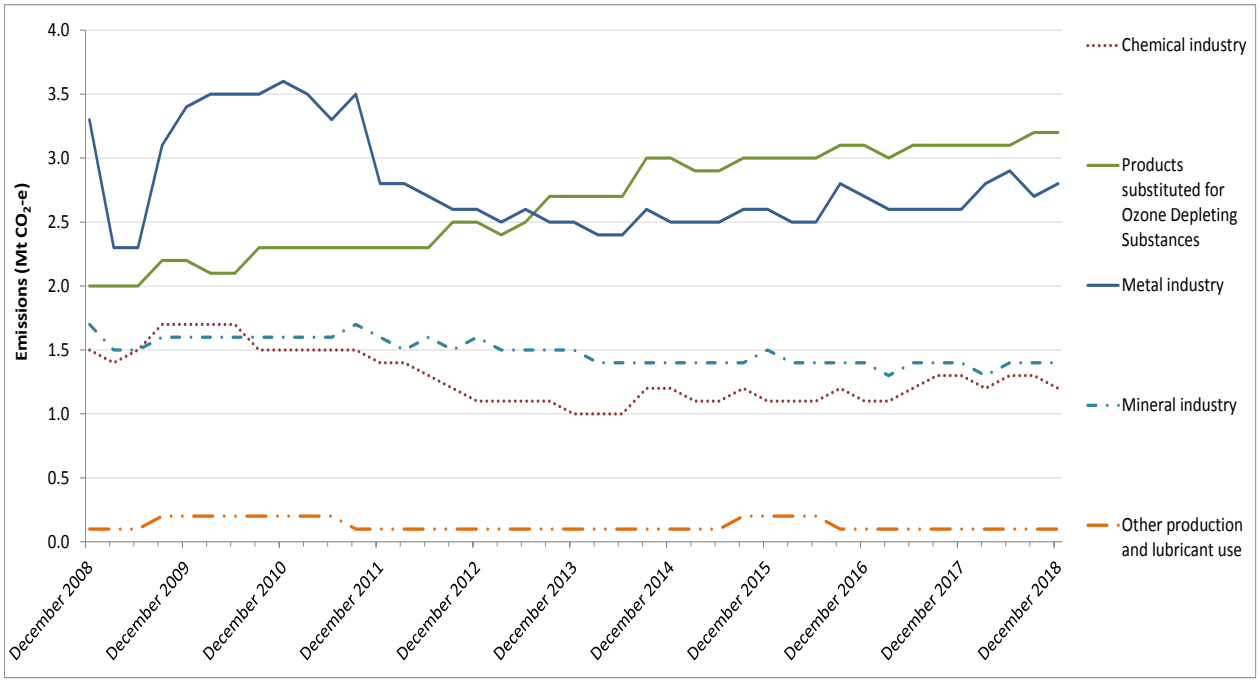
[11] Department of Industry, Innovation and Science (2019). *Resources and Energy Quarterly, March 2019*

2.5 Industrial processes and product use

Emissions from *industrial processes and product use* occur as the result of by-products of materials and reactions used in production processes. This sector includes emissions from processes used to produce chemical, metal, and mineral product. It also includes emissions from the consumption of synthetic gases.

In the year to December 2018, *industrial processes and product use* accounted for 6.4 per cent of Australia's national inventory (Figure 4).

Figure 16: *Industrial processes and product use* emissions, unadjusted, by sub-sector, by quarter, December 2008 to December 2018



Source: Department of the Environment and Energy

Trend emissions for *industrial processes and product use* decreased by 1.2 per cent in the December quarter 2018, however, trend emissions increased 2.3 per cent over the year to December 2018. The annual increase was largely due to increasing iron and steel production of 10.6 per cent, and a 1.3 per cent increase in emissions from products used as substitutes for ozone depleting substances (Figure 16).

2.6 Agriculture

Emissions from *agriculture* include methane, nitrous oxide and carbon dioxide. Methane and nitrous oxide emissions are estimated for enteric fermentation and manure management in livestock. They are also estimated for rice cultivation, agricultural soils and field burning of agricultural residues. Carbon dioxide emissions are reported from the application of urea and lime (Figure 17).

Figure 17: *Agriculture* emissions, unadjusted, by sub- sector, year to December, 1990 to 2018

Source: Department of the Environment and Energy

In the year to December 2018, *agriculture* accounted for 12.9 per cent of Australia's national inventory (Figure 4).

Emissions from *Agriculture* have decreased by 3.3 per cent over the year to December 2018. This decline is driven mainly by decreases in emissions from enteric fermentation, which reflects a decline in the beef cattle population. In addition, there were decreases in emissions from agricultural soils and field burning of agricultural residues. This was the result of a return to more regular production conditions following the above average to exceptional yields in much of the Australian cropping region in 2016-17.

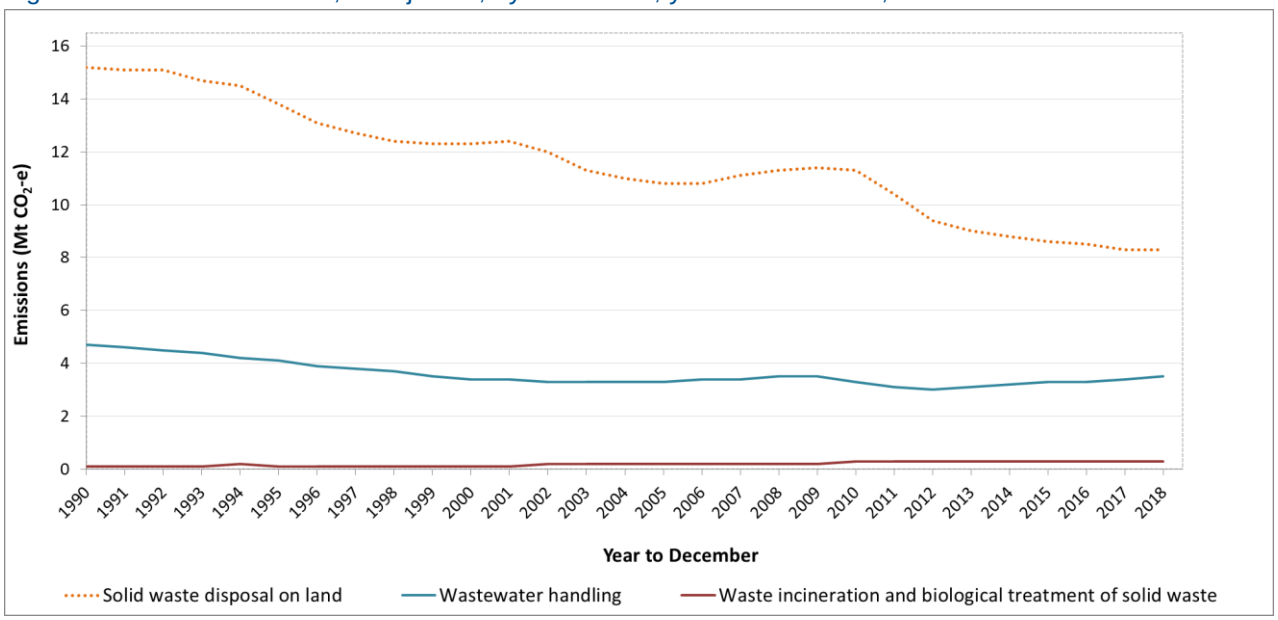
2.7 Waste

The *waste* sector includes emissions from landfills, wastewater treatment, waste incineration and the biological treatment of solid waste. Emissions largely consist of methane, which is generated when organic matter decays under anaerobic conditions.

In the year to December 2018, *waste* accounted for 2.2 per cent of Australia's national inventory (Figure 4).

Emissions from *waste* increased 1.1 per cent over the year to December 2018 due to a 3.9 per cent increase in emissions from wastewater treatment and discharge (Figure 18). This reflects lower rates of methane capture from wastewater treatment and discharge being reported by wastewater facilities.

Figure 18: *Waste* emissions, unadjusted, by sub-sector, year to December, 1990 to 2018



Source: Department of the Environment and Energy

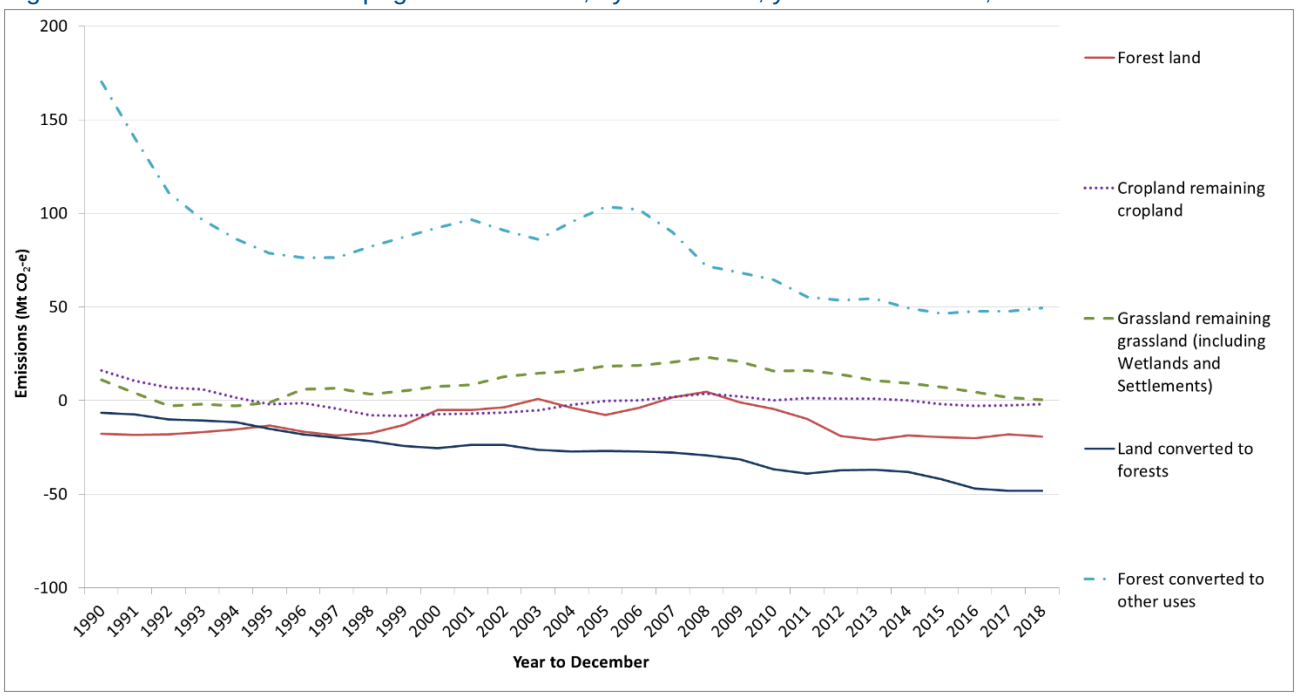
2.8 Land Use, Land Use Change and Forestry

The *Land Use, Land Use Change and Forestry (LULUCF)* sector of the national inventory includes estimates of net anthropogenic emissions for forests and agricultural lands and changes in land use.

In the year to December 2018, the *LULUCF* sector[12] accounted for a net sink equivalent to 3.6 per cent of Australia's national inventory (Figure 4).

Net emissions for the *LULUCF* sector in the year to December 2018 are estimated to be a sink of 19.5 Mt CO_2-e (Figure 19). The sink of emissions decreased by 0.4 per cent (0.1 Mt CO_2-e) on the previous twelve months (Table 3).

Figure 19: *LULUCF* net anthropogenic emissions, by sub-sector, year to December, 1990 to 2018



Source: Department of the Environment and Energy

[12] *LULUCF* includes Forest conversion, Forest land remaining forest land, Land converted to forest land, Grasslands (including Wetlands and Settlements) and Croplands

3. Emissions per capita and per dollar of GDP

Emissions per capita, and the emissions intensity of the economy[13], were at their lowest levels in 29 years.

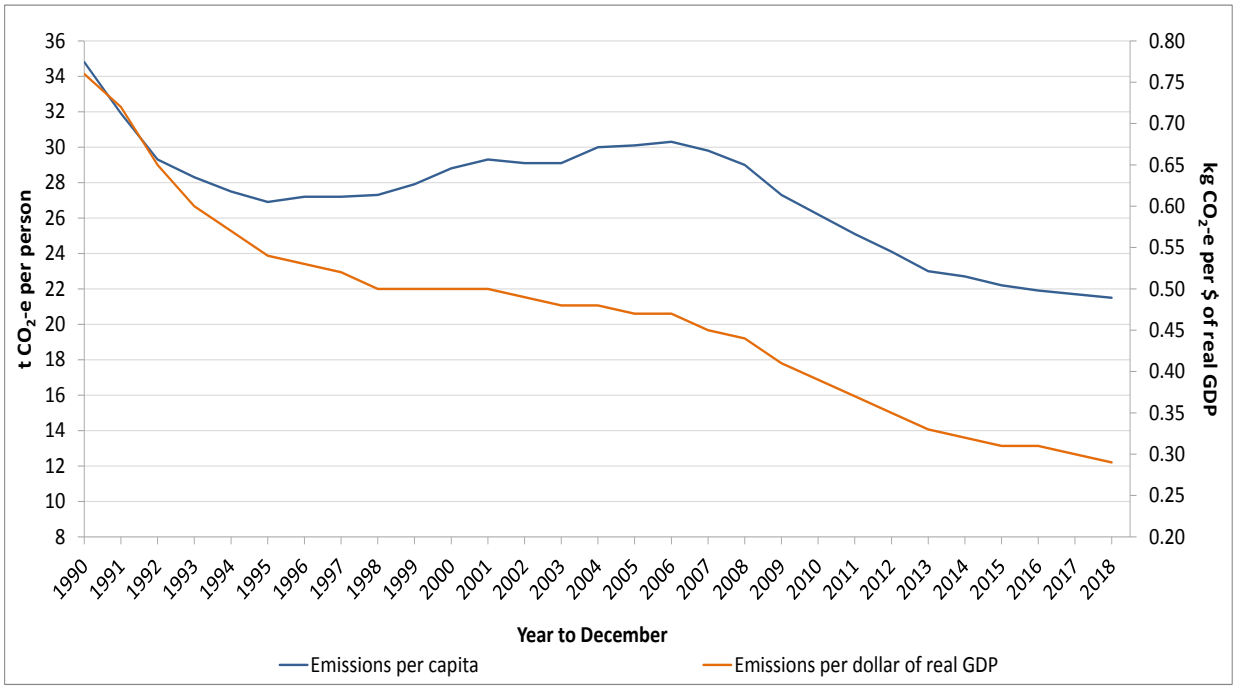
In the year to December 2018, national inventory emissions per capita were 21.5 t CO_2-e per person. This represents a 38.2 per cent decline in national inventory emissions per capita from 34.8 t CO_2-e in 1990.

Over the period from 1989-90 to December 2018, Australia's population grew strongly from 17.2 million to around 25.2 million. This reflects a growth rate of 46.8 per cent.[14,15]

Australia's GDP (2015-16 prices)[16] also experienced significant growth over this period, expanding from $0.8 trillion in 1989-90 to around $1.8 trillion in the year to December 2018. This represents a growth of 134.4 per cent.

National inventory emissions per dollar of real GDP fell from 0.76 kg CO_2-e per dollar in 1990 to 0.29 kg CO_2-e per dollar in the year to December 2018 (Figure 20). This represents a decline of 61.4 per cent from the year to December 1990.[10]

Figure 20: Emissions per capita and per dollar of real GDP (2015-16 prices), unadjusted, year to December 1990 to 2018



Source: Department of the Environment and Energy

[13] Emissions per capita and per dollar of real GDP levels are inclusive of all sectors of the economy, including *Land Use, Land Use Change and Forestry* (LULUCF)

[14] Australian Bureau of Statistics (2018), *Australian Demographic Statistics*, pub. no. 3101 http://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0

[15] Australian Bureau of Statistics (2018), *Population Clock*. http://www.abs.gov.au/AUSSTATS/abs@.nsf/Web+Pages/Population+Clock

[16] 2015-16 prices, Australian Bureau of Statistics (2018), *National Accounts: National Income, Expenditure and Product*, pub. no. 5206 http://www.abs.gov.au/ausstats/abs@.nsf/mf/5206.0

4. Short Lived Climate Forcers

With an increased global focus on short lived climate forcers (SLCF) and their role in affecting climate, *Black carbon* emissions from combustion processes have been included for the first time in this report along with other aerosols ($PM_{2.5}$) and ozone and aerosol precursors (sulphur dioxide and PM_{10}). These substances are already included in Australia's National Greenhouse Gas Inventory submission to the United Nations Framework Convention on Climate Change.

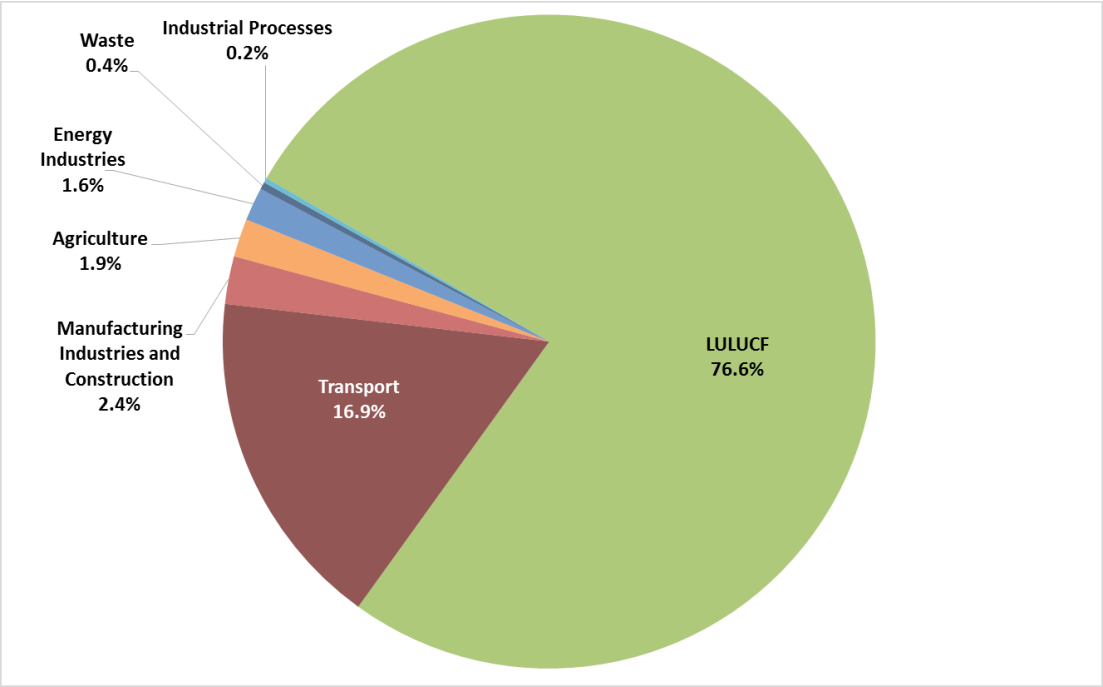
4.1 Aerosols – Black Carbon, $PM_{2.5}$

Black carbon, an aerosol (airborne particle) emitted from combustion processes is emitted as a component of particulate matter less than or equal to 2.5 micrometres (≤ 2.5 μm) in diameter ($PM_{2.5}$). Data from the National Pollutant Inventory (NPI)[17], has been used in conjuction with greenhouse gas data to derive national black carbon estimates.

This *Update* provides estimates of black carbon emissions for *energy*, *industrial processes and product use*, *waste*, *transport*, residential burning and biomass burning for the year to December 2017 to the year to December 2018.

In the year to December 2018, *LULUCF* accounted for 76.6 per cent of Australia's national black carbon inventory (Figure 21). The *transport* sector is the second largest contributor (16.9 per cent) to Australia's black carbon emissions due to combustion of diesel fuel in heavy vehicles and kerosene in aviation.

Figure 21: *Black carbon* emissions contribution, by sector, for the year to December 2018



The 1.5 per cent or 5.0 kt increase in black carbon emissions over the year to December 2018 reflect increases in emissions from the energy sector (including diesel use in transport). This was partially offset by decreases in emissions from the LULUCF sector (Table 4).

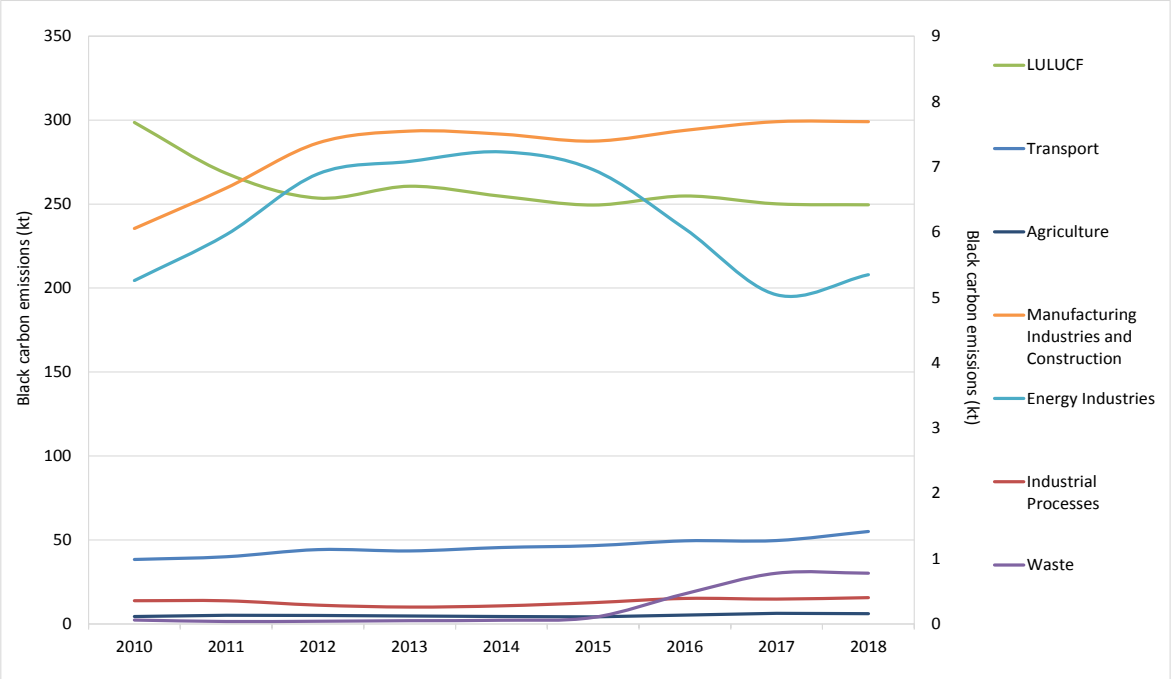
[17] http://www.npi.gov.au/

Table 4: *Black carbon* emissions, by sector, for the years to December 2017 and 2018

Sector	Annual emissions (kt)		Change (%)
	Year to December 2017	Year to December 2018	
Energy – Fuel Combustion	63.1	68.8	9.0
Energy Industries	5.0	5.3	6.1
Energy – Manufacturing Industries and Construction	7.7	7.7	0.0
Energy – Other Sectors	0.4	0.4	0.0
Energy – Transport	50.0	55.4	10.9
Industrial processes and product use	0.4	0.4	5.8
Agriculture	6.4	6.1	-3.3
Waste	0.8	0.8	0.0
Land Use, Land Use Change and Forestry	250.1	249.6	-0.2
Black Carbon Total	**320.7**	**325.7**	**1.5**

The increase in black carbon emissions for *transport* is attributed to increased diesel passenger vehicle sales and freight activity, supported by steady economic and population growth, and switching to diesel vehicles (Figure 13).

Figure 22: *Black carbon* emissions, by sector, by quarter, December 2010 to December 2018



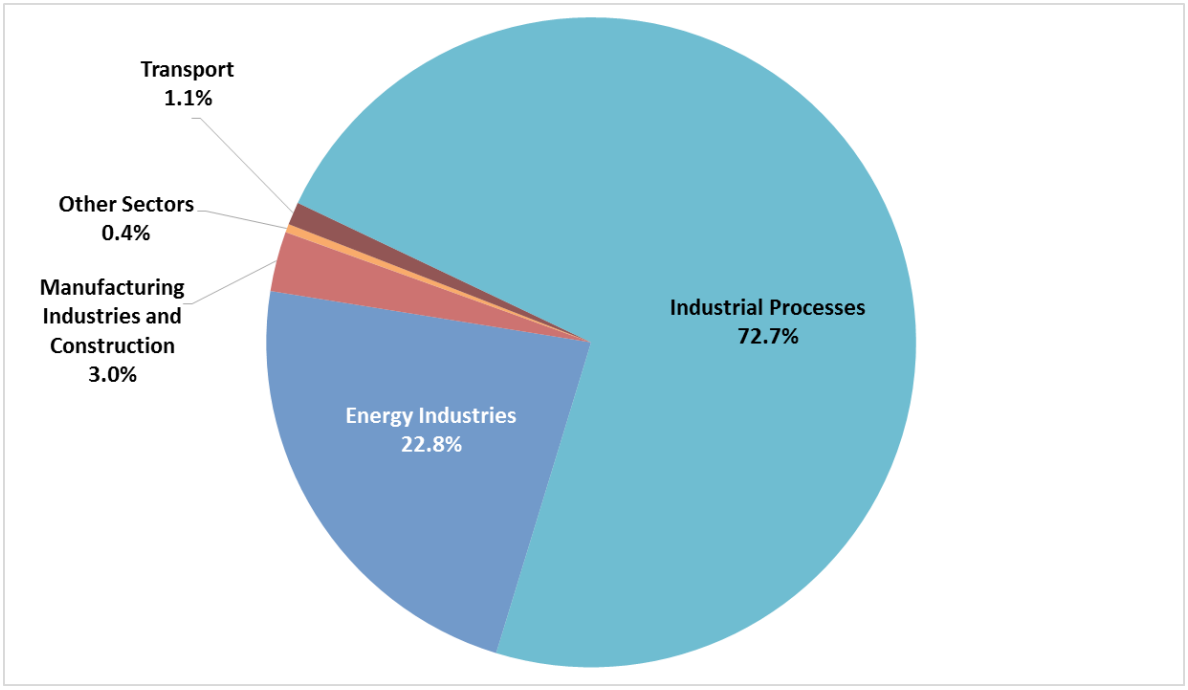
Source: Department of the Environment and Energy

4.2 Ozone and aerosol precursors – Sulphur dioxide, PM_{10}

Measured data from the NPI for sulphur dioxide (SO_2) and the aerosol particulate matter less than or equal to 10 micrometres (≤ 10 µm) in diameter (PM_{10}) has also been published in this report, for *energy*, *waste* and *industrial processes and product use* from the year to December 2010.

For SO_2, in the year to December 2018, *metal production* (copper and zinc) accounted for 72.7 per cent of Australia's national inventory (Figure 23). *Energy industries* comprises electricity generation, petroleum refining and coal production is the second largest contributor (22.8 per cent) to Australia's SO_2, emissions. These emissions are primarily associated with *electricity production*.

Figure 23: Sulphur dioxide emissions contribution, by sector, for the year to December 2018



Source: Department of the Environment and Energy

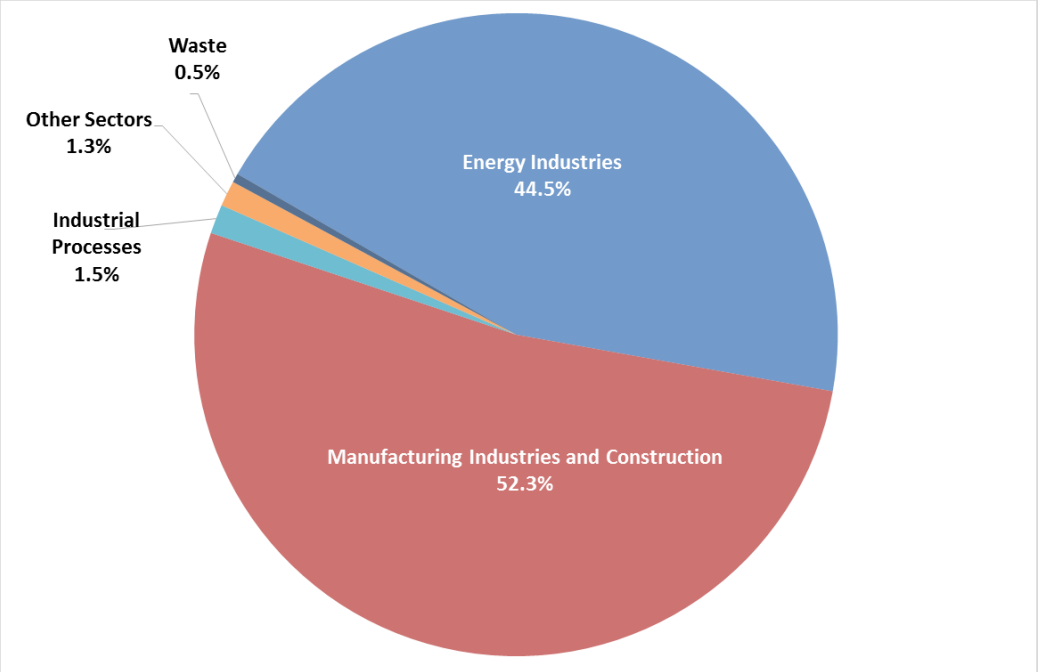
The 2.8 per cent or 61.6 kt increase in emissions over the year to December 2018 mainly reflects increases in emissions from *metal production* (Table 5). These increases in emissions were partially offset by decreases in emissions from the *transport* and *electricity generation* sectors.

Table 5: Sulphur dioxide emissions, by sector, for the years to December 2017 and 2018

Sector	Annual emissions (kt)		Change (%)
	Year to December 2017	Year to December 2018	
Energy – Fuel Combustion	633.1	624.6	-1.3
Energy Industries	535.6	521.0	-2.7
Energy – Manufacturing Industries and Construction	63.6	68.0	7.0
Energy – Other Sectors	9.3	9.3	0.0
Energy – Transport	24.6	26.3	6.9
Industrial processes and product use	1590.1	1660.2	4.4
Sulphur Dioxide Total	**2223.2**	**2284.8**	**2.8**

For the aerosol PM_{10}, in the year to December 2018, *manufacturing industries and construction* (including *mining and quarrying*) accounted for 52.3 per cent of Australia's national inventory (Figure 24). The *manufacture of solid fuels and other energy* (the primary component of *Energy Industries*) is the second largest contributor (42.1 per cent) to Australia's SO_2 emissions due to *coal mining*.

Figure 24: PM_{10} emissions contribution, by sector, for the year to December 2018



Source: Department of the Environment and Energy

The 2.5 per cent or 22.8 kt increase in emissions over the year to December 2018 reflects increases in emissions from the *energy* and *metal production* sectors (Table 6).

Table 6: PM_{10} emissions, by sector, for the years to December 2017 and 2018

Sector	Annual emissions (kt)		Change (%)
	Year to December 2017	Year to December 2018	
Energy – Fuel Combustion	900.9	922.9	2.4
Energy Industries	396.6	418.6	5.6
Energy – Manufacturing Industries and Construction	492.2	492.2	0.0
Energy – Other Sectors	12.1	12.1	0.0
Industrial processes and product use	13.0	13.8	5.8
Waste	4.3	4.3	0.0
PM_{10} Total	**918.2**	**941.0**	**2.5**

5. Technical notes

5.1 Quarterly coverage

The *Quarterly Update* uses emissions estimates based on our United Nations Framework Convention on Climate Change (UNFCCC) inventory time series to better support implementation of Australia's 2030 target. The UNFCCC inventory will be used to track progress towards Australia's commitment to reduce emissions levels by 2030 under the Paris Agreement.

5.2 International guidelines

The *Quarterly Update* has been prepared in accordance with the international guidelines agreed for use at the Conference of the Parties (COP) of the UNFCCC in Warsaw 2013 including the *Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories* (2006).

5.3 Greenhouse gases and short lived climate forcers

This report covers sources of greenhouse gas emissions and removals by sinks resulting from human (anthropogenic) activities for the major greenhouse gases listed in Table 7 below.

For the first time this report also reports on some select aerosols and ozone and aerosol precursors known as short lived climate forcers (Table 7).

Table 7: Major greenhouse gases and short lived climate forcers covered by the Quarterly Update

Major greenhouse gases	Short lived climate forcers
Carbon dioxide (CO_2)	particulate matter less than or equal to 2.5 micrometres ($PM_{2.5}$)
Methane (CH_4)	Black carbon (BC)
Nitrous oxide (N_2O)	particulate matter less than or equal to 10 micrometres (PM_{10})
Perfluorocarbons (PFCs)	Sulphur dioxide (SO_2)
Hydrofluorocarbons (HFCs)	
Sulphur hexafluoride (SF_6)	

Australia's emissions of the greenhouse gas nitrogen trifluoride (NF_3) are considered negligible and are not estimated.

Global warming potentials (GWPs) have been used for each of the major greenhouse gases to convert them to carbon dioxide equivalents (CO_2-e). As greenhouse gases vary in their radiative activity and in their atmospheric residence time, converting emissions into CO_2-e allows the integrated effect of emissions of the various gases to be compared. The GWPs used in this Report were the 100-year GWPs contained in the 2007 IPCC Fourth Assessment Report (IPCC 2007), by international agreement.

Short lived climate forcers are gases and particles that affect the climate. They have lifetimes in the atmosphere of a few days to a decade, and many of them are also air pollutants. They are referred to as near-term climate forcers (NTCF) in the IPCC Fifth Assessment Report (AR5), which are a set of compounds whose impact on climate occurs primarily within the first decade after their emission. This set of compounds includes ozone and aerosols, or their precursors, and some halogenated species that are not well-mixed greenhouse gases (Annex 3 Glossary, Working Group I contribution to AR5).

GWPs are not applied to the short lived climate forcers, they are therefore reported in mass units.

5.4 Quarterly methodology and growth rates

Emission estimates have been compiled by the Department using the estimation methodologies incorporated in the Australian Greenhouse Emissions Information System (AGEIS) and documented in the National Inventory Report.

The estimates are calculated using the latest national inventory data and indicators from external data sources (listed in Section 5.6). These data are used to determine growth rates, which are applied to estimate quarterly emissions growth.

Quarterly growth rates are calculated as the percentage change between the estimates for the previous quarter and the current quarter. Annual growth rates are calculated as the percentage change between the estimates for the twelve months to the end of the equivalent quarter in the previous year, and the twelve months to the end of the current quarter.

5.5 Recalculations

Periodic recalculations of the quarterly emission estimates are undertaken as more complete and accurate information becomes available, and in response to changes in international reporting requirements.

Recalculations comply with international guidelines, are estimated on a time series consistent basis and are subject to annual international expert review.

Recalculations since the September Quarter 2018

The recalculations since the September 2018 edition of the *Quarterly Update* for the financial years 2005 and 2016 to 2018 (and including the first quarter of 2019), by sector in Mt CO_2-e, are shown in Table 8.

Table 8: Recalculations (Mt CO_2-e) since the September 2018 *Quarterly Update*, by sector, 2005 and 2016 to 2019

Sector	Financial Years and Quarters														
	2005				2016				2017				2018		
	Mar	Jun	Sep	Dec	Mar	Jun	Sep	Dec	Mar	Jun	Sep	Dec	Mar	Jun	Sep
Agriculture	-0.1	-0.1	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1
Electricity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stationary energy (excluding electricity)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	-0.1	-0.1
Transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fugitive emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	-0.2	-0.3
Industrial processes and product use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Waste	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LULUCF	1.6	1.6	-0.7	-0.7	1.9	1.9	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total	**1.5**	**1.6**	**-0.7**	**-0.7**	**1.8**	**1.8**	**0.5**	**0.5**	**0.5**	**0.6**	**0.7**	**0.6**	**0.4**	**0.1**	**-0.1**

Revisions to Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) livestock, crop and rice data.

Revisions to Department of Industry, Innovation and Science (DIIS) commodities production data resulted in recalculations to *stationary energy (excluding electricity)*, *fugitive emissions*, and *industrial processes and product use*.

Recalculations to *LULUCF* reflect improvements made to the annual collection and processing of activity data and to emissions estimation methods for the LULUCF sector. These improvements are described in the latest annual National Inventory Report to the UNFCCC (published in May 2019).

Routine recalculations

The national inventory is subject to continuous improvement in line with the national inventory improvement plan. All methods and data sources are kept under review to ensure that the inventory is consistent with international guidelines, is able to use the best data available, including new National Greenhouse and Energy Reporting (NGER) data, and takes account of the latest empirical science.

5.6 Source data

Preliminary activity data are obtained under the NGERs and from a range of publicly available sources, principally:

- Australian Bureau of Statistics (2018), Australian Demographic Statistics, pub. no. 3101 http://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0
- Australian Bureau of Statistics (2018), Population Clock. http://www.abs.gov.au/AUSSTATS/abs@.nsf/Web+Pages/Population+Clock
- Australian Bureau of Agricultural and Resource Economics and Sciences (2019*). Agricultural Commodities, March Quarter 2019.*
- Australian Bureau of Statistics (2018), *National Accounts: National Income, Expenditure and Product*, pub. no. 5206 http://www.abs.gov.au/ausstats/abs@.nsf/mf/5206.0
- AEMO – Market data extracted using NEM-Review software: http://www.aemo.com.au/Electricity/Data
- BITRE – Domestic Totals & Top Routes: http://www.bitre.gov.au/publications/ongoing/domestic_airline_activity-time_series.aspx
- BoM - Monthly climate summaries: http://www.bom.gov.au/
- Department of Industry, Innovation and Science (2019). *Resources and Energy Quarterly, March 2019*
- Department of Industry and Science (2018). Australian Energy Statistics: Table F. https://www.energy.gov.au/publications/australian-energy-update-2018
- DoEE – Australian Greenhouse Emissions Information System: http://ageis.climatechange.gov.au/

5.7 Unadjusted time series

The ABS defines an original time series as showing 'the actual movements in the data over time'. The unadjusted time series' in this report are equivalent to an original time series.

5.8 Seasonal adjustment analysis

The ABS defines seasonal adjustment as follows: 'A seasonally adjusted time-series is a time-series with seasonal component removed. This component shows a pattern over one year or less and is systemic or calendar related.'

The unadjusted quarterly data have been adjusted using SEASABS to remove the effects of seasonal factors. SEASABS is a standard seasonal adjustment tool, consistent with methods applied by the ABS. SEASABS analysis for the *Quarterly Update* uses a 5 term Henderson moving average.

5.9 Trend analysis

The trend series provides the best indication of underlying movements in the inventory by smoothing short term fluctuations in the seasonally adjusted series, caused for example, by extreme weather events such as floods or fires. The trend time series is estimated using the SEASABS tool. More information on trend analysis is available on the ABS website http://www.abs.gov.au/websitedbs/D3310114.nsf/home/Time+Series+Analysis:+The+Basics.

5.10 Weather normalisation

The seasonally adjusted and trend estimates are further adjusted to correct for the effects of variations around average seasonal temperatures. This process is termed 'weather normalisation' and is designed to provide a clearer indication of the underlying trends in the emissions data.

Seasonal temperatures are an important predictor of emissions in Australia due to their influence on demand for electricity for heating and cooling (air conditioning). The seasonally adjusted series corrects for the regular effects of differences in average temperatures between seasons. The weather normalised series further corrects for fluctuations in average seasonal conditions.

The weather normalisation methodology is based on the Bureau of Meteorology concept of 'heating and cooling degree days,' and is applied to total emissions (excluding *LULUCF*) and the *electricity* sector. The methodology is described in detail in 'Section 7: Special Topic' of the December 2011 edition of the *Quarterly Update*.

5.11 Quarterly uncertainty

For all sectors the Department's assessment is that the 90 per cent confidence interval for the national inventory is ± 6.5 per cent (i.e. there is a 90 per cent probability that future revisions will be limited to ± 6.5 per cent of the current estimate).

5.12 Sectoral emissions sources and sinks

Energy:

Electricity:

- Emissions from the combustion of fuel used to generate electricity for public use.

Stationary energy excluding electricity:

- Energy industries: petroleum refining, gas processing and solid fuel manufacturing (including coal mining and oil/gas extraction and processing).
- Manufacturing industries and construction: direct emissions from the combustion of fuel to provide energy used in manufacturing such as steel, non-ferrous metals, chemicals, food processing, non-energy mining and pulp and paper.
- Other sectors: energy used by the commercial, institutional, residential sectors as well as fuel used by the agricultural, fishery and forestry equipment. This also includes all remaining fuel combustion emissions associated with military fuel use.

Transport:

- Road transport: passenger vehicles, light commercial vehicles, trucks, buses and motorcycles.
- Domestic air transport: commercial passenger and light aircraft on domestic routes using either aviation gasoline or jet kerosene. International air transport is reported but not included in Australia's total emissions (in line with international guidelines).
- Coastal shipping: domestic shipping and small craft. International shipping is reported but not included in Australia's total emissions (in line with international guidelines).
- Rail transport: railways, but not electric rail, where fuel combustion is covered under the electricity sector.
- Transmission of natural gas.

Fugitive emissions:

Emissions, other than those attributable to energy use, from:

- Solid fuels: CO_2 and CH_4 from coal mining activities, post-mining and decommissioned mines and CO_2, CH_4 and N_2O from flaring associated with coal mining.
- Oil and natural gas: exploration, extraction, production, processing and transportation of natural gas and oil. Includes leakage, evaporation and storage losses, flaring and venting of CO_2, CH_4 and N_2O.

Industrial processes and product use:

- Mineral industry: CO_2 from cement clinker and lime production; the use of limestone and dolomite and other carbonates in industrial smelting and other processes; soda ash production and use; and magnesia production.
- Metal industry: CO_2 and PFCs from aluminium smelting; CO_2, CH_4 and N_2O from iron and steel production; and CO_2 from the production of ferroalloys and other metals.

- Chemical Industry: includes N_2O from the production of nitric acid; CO_2, from ammonia production, acetylene use and the production of synthetic rutile and titanium dioxide; and CH_4 from polymers and other chemicals.
- Other product manufacture and use: CO_2 from the consumption of CO_2 in the food and drink industry and the use of sodium bicarbonate, SF_6 from electrical equipment.
- Product uses as substitutes for Ozone Depleting Substances: HFC and refrigeration and air conditioning equipment, foam blowing, metered dose inhalers, fire extinguishers, solvent use.
- Non-energy products from fuel and solvent use: CO_2 produced by oxidation of lubricating oils and greases.

Agriculture:

CH_4 and N_2O emissions from the consumption, decay or combustion of living and dead biomass, including:

- Enteric fermentation in livestock: emissions associated with microbial fermentation during digestion of feed by ruminant (mostly cattle and sheep) and some non-ruminant domestic livestock.
- Manure management: emissions associated with the decomposition of animal wastes while held in manure management systems.
- Rice cultivation: CH_4 emissions from anaerobic decay of organic material when rice fields are flooded.
- Agricultural soils: emissions associated with the application of fertilisers, crop residues and animal wastes to agricultural lands and the use of biological nitrogen fixing crops and pastures.
- Field burning of agricultural residues: emissions from field burning of cereal and other crop stubble, and the emissions from burning sugar cane prior to harvest.
- Carbon dioxide emissions from the application of urea and lime.

Waste:

Emissions are predominantly CH_4. Small amounts of CO_2 and N_2O are generated through incineration and the decomposition of human wastes respectively. The main sources are:

- Solid waste: emissions resulting from anaerobic decomposition of organic matter in landfills.
- Wastewater: emissions resulting from anaerobic decomposition of organic matter in sewerage facilities (including on-site systems such as septic tanks) during treatment and disposal of wastewater.
- Incineration: emissions resulting from the incineration of solvents and clinical waste.
- Biological treatment of solid waste: emissions resulting from the anaerobic decomposition of organic material in composting and anaerobic digester facilities.

Land Use, Land Use Change and Forestry:

The *LULUCF* sector includes:

- Forest converted to other land uses: emissions and removals from the direct human-induced removal of forest and replacement with pasture, crops or other uses since 1990. Emissions arise from the burning and decay of cleared vegetation, and changes in soil carbon from current and past events.
- Land converted to forest: emissions and removals (i.e. sinks) from forests established on agricultural land. Growth of the forests and regrowth on cleared lands provides a carbon sink, while emissions can arise from soil disturbance on the cleared lands (N_2O). Both new plantings and the regeneration of forest from natural seed sources contribute to this classification as well as sequestration projects under the Emission Reduction Fund.
- Forest land remaining forest land: emissions and removals in forests managed under a system of practices designed to support commercial timber production such as harvest or silvicultural practices or practices that are designed to implement specific sink enhancement activities. Forest harvesting causes emissions due to the decay of harvest slash and any subsequent prescribed burning. The regrowth of forests following harvesting provides a carbon sink and the harvested wood product pool can be a carbon sink or source depending on the rate of input and the rate of decay. Wildfire emissions on forest management land are reported using the natural disturbances provision.
- Cropland: Anthropogenic emissions and removals on croplands occur as a result of changes in management practices on cropping lands, from changes in crop type (particularly woody crops) and from changes in land use.
- Grazing land: Anthropogenic emissions and removals on grasslands result from changes in management practices on grass lands, particularly from changes in pasture, grazing and fire management; changes in woody biomass elements and from changes in land use.
- Wetlands: Net emissions from the coastal lands including dredging of seagrass, aquaculture, and loss of tidal marsh areas. Changes in mangroves are reported under forest classifications.

5.13 Measurements

The units used in this quarterly update inventory are:

grams (g)

tonnes (t)

metres (m)

litres (L)

Standard metric prefixes used in this inventory are:

kilo (k) = 10^3 (thousand)

mega (M) = 10^6 (million)

giga (G) = 10^9

tera (T) = 10^{12}

peta (P) = 10^{15}

In this report, emissions are expressed in Mt CO_2-e, which represents millions of tonnes of carbon dioxide equivalent gas.

Short lived climate forcers are expressed in kt which represents thousands of tonnes of the respective gas or particle.

5.14 Future publications

The March 2019 Quarterly Update of Australia's National Greenhouse Gas Inventory will be published by 31 August 2019.

6. Data tables

Data Table 1A: Unadjusted emissions (Mt), by sector, by quarter, since 2001-02[18]

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions					
2001-2002	September	47.5	19.4	18.9	10.2	7.3	19.5	4.0	16.6	143.4
	December	44.3	19.4	19.6	9.6	7.1	19.5	4.0	16.6	139.9
	March	45.4	18.6	18.5	8.9	6.9	19.0	3.9	16.2	137.4
	June	46.8	19.2	18.7	9.8	7.3	19.2	4.0	16.4	141.3
2002-2003	September	48.6	19.9	19.6	9.9	7.8	18.1	3.8	18.7	146.4
	December	46.2	19.9	20.2	9.1	7.8	18.1	3.8	18.7	143.8
	March	45.4	19.1	19.1	8.5	7.8	17.7	3.7	18.3	139.7
	June	46.4	19.5	19.3	9.5	7.7	17.9	3.7	18.5	142.6
2003-2004	September	49.0	20.3	20.3	10.0	8.3	18.9	3.6	16.6	147.1
	December	46.8	20.3	21.0	9.2	8.3	18.9	3.6	16.6	144.8
	March	50.0	19.4	19.8	8.6	8.1	18.7	3.6	16.4	144.7
	June	49.1	19.9	20.0	9.7	7.9	18.7	3.6	16.4	145.4
2004-2005	September	50.9	20.8	20.8	10.2	8.0	19.1	3.6	22.4	155.9
	December	48.2	20.9	21.1	9.6	8.0	19.1	3.6	22.4	152.9
	March	48.8	19.8	19.7	8.9	7.9	18.7	3.5	21.9	149.3
	June	48.9	20.4	20.6	10.0	8.0	18.9	3.6	22.1	152.6
2005-2006	September	50.9	20.7	20.6	10.5	8.2	18.7	3.6	21.4	154.6
	December	48.9	20.5	21.9	9.8	8.0	18.7	3.6	21.4	152.8
	March	50.6	19.4	20.5	9.2	7.8	18.3	3.5	21.0	150.3
	June	50.9	20.6	20.5	10.5	8.0	18.5	3.5	21.2	153.8

[18] This table presents estimates of quarterly emissions by sector since 2001-02, in unadjusted terms. As numbers are rounded, the sum of the sectors may not exactly equal the totals.

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions					
2006-2007	September	52.2	20.5	21.2	10.9	8.5	17.8	3.7	23.7	158.5
	December	50.8	21.0	22.0	10.3	8.6	17.8	3.7	23.7	157.9
	March	51.6	19.8	21.2	9.7	8.4	17.4	3.6	23.2	154.8
	June	49.5	20.6	21.4	11.0	8.6	17.6	3.6	23.4	155.8
2007-2008	September	53.5	21.4	21.7	11.8	8.7	17.1	3.8	19.8	157.7
	December	50.3	21.3	22.3	9.9	8.6	17.1	3.8	19.8	153.0
	March	51.7	20.3	21.3	9.9	8.5	16.9	3.7	19.6	151.9
	June	50.5	21.4	21.7	10.6	8.6	16.9	3.7	19.6	153.1
2008-2009	September	55.4	22.1	22.1	10.7	9.3	17.3	3.8	17.6	158.3
	December	52.3	21.6	22.6	10.7	8.7	17.3	3.8	17.6	154.5
	March	52.5	19.4	21.2	9.5	7.3	16.9	3.7	17.2	147.5
	June	51.5	20.5	21.5	11.2	7.5	17.1	3.7	17.4	150.4
2009-2010	September	51.4	20.8	22.4	11.3	8.6	16.7	3.8	12.3	147.3
	December	51.3	21.3	22.9	10.3	9.0	16.7	3.8	12.3	147.5
	March	52.5	20.5	21.4	9.9	9.1	16.3	3.8	12.0	145.5
	June	49.9	21.3	22.1	10.8	9.0	16.5	3.8	12.1	145.6
2010-2011	September	51.0	21.9	22.8	11.6	9.1	17.8	3.7	7.4	145.3
	December	47.1	21.6	23.7	10.8	9.2	17.8	3.7	7.4	141.3
	March	50.7	20.1	22.1	9.0	9.0	17.4	3.6	7.2	139.1
	June	49.7	21.6	22.8	10.2	8.9	17.6	3.6	7.3	141.9
2011-2012	September	50.9	23.2	22.5	10.8	9.2	18.1	3.3	4.6	142.4
	December	49.2	22.7	22.9	10.5	8.2	18.1	3.3	4.6	139.3
	March	50.3	21.4	23.1	9.6	8.1	17.9	3.2	4.5	138.2
	June	48.7	22.1	23.4	11.1	7.9	17.9	3.2	4.5	138.9

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions					
2012-2013	September	47.0	24.1	23.2	11.0	8.0	18.2	3.1	1.8	136.5
	December	45.9	23.9	23.9	10.6	8.0	18.2	3.1	1.8	135.4
	March	47.6	22.2	22.2	9.8	7.7	17.8	3.0	1.8	132.1
	June	46.6	23.2	22.8	10.6	7.8	18.0	3.1	1.8	133.9
2013-2014	September	45.0	23.9	23.4	10.3	7.9	18.3	3.1	2.0	134.2
	December	44.0	23.9	23.9	10.2	7.9	18.3	3.1	2.0	133.4
	March	47.2	22.5	22.7	10.1	7.6	17.9	3.1	2.0	133.1
	June	44.5	23.7	23.2	10.2	7.7	18.1	3.1	2.0	132.5
2014-2015	September	47.5	23.4	24.0	12.4	8.3	17.7	3.0	-0.9	135.4
	December	46.4	22.9	24.5	11.1	8.3	17.7	3.0	-0.9	132.9
	March	47.9	21.8	23.3	10.4	8.0	17.3	2.9	-0.9	130.8
	June	47.2	22.6	23.5	11.6	8.2	17.5	3.0	-0.9	132.7
2015-2016	September	49.3	23.4	24.1	12.5	8.4	17.4	3.1	-4.1	134.1
	December	48.0	23.3	24.5	11.9	8.4	17.4	3.1	-4.1	132.6
	March	49.9	22.3	24.0	12.1	8.1	17.2	3.1	-4.1	132.6
	June	47.5	23.3	23.8	12.2	8.2	17.2	3.1	-4.1	131.2
2016-2017	September	48.6	24.2	24.5	12.9	8.6	18.4	3.0	-4.9	135.3
	December	45.3	24.2	25.8	12.6	8.5	18.4	3.0	-4.9	132.8
	March	49.4	22.6	23.9	12.4	8.2	18.0	2.9	-4.8	132.6
	June	45.9	24.4	24.5	13.9	8.4	18.2	2.9	-4.8	133.3
2017-2018	September	45.7	25.0	25.1	14.7	8.5	17.8	3.0	-5.0	134.9
	December	44.4	25.0	25.5	14.5	8.6	17.8	3.0	-5.0	133.8
	March	46.2	24.2	24.9	13.3	8.6	17.4	3.0	-4.8	132.8
	June	45.1	25.6	25.6	14.3	8.7	17.6	3.0	-4.9	135.1

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions					
2018-2019	September	44.7	26.5	25.4	14.7	8.7	17.2	3.0	-4.9	135.4
	December	42.9	26.4	25.9	15.7	8.7	17.2	3.0	-4.9	135.0
	March	-	-	-	-	-	-	-	-	-
	June	-	-	-	-	-	-	-	-	-

Data Table 1B: Seasonally adjusted emissions (Mt), by sector, by quarter, since 2001-02[19]

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions					
2001-2002	September	46.2	18.9	18.7	9.6	7.1	19.3	4.0	15.9	140.0
	December	45.2	19.1	18.9	9.8	7.0	19.3	4.0	16.3	139.7
	March	45.9	19.2	19.0	9.6	7.1	19.2	4.0	16.6	140.6
	June	46.7	19.3	19.1	9.5	7.4	19.3	4.0	16.7	141.6
2002-2003	September	47.2	19.4	19.3	9.4	7.6	18.0	3.7	18.2	143.1
	December	47.1	19.6	19.5	9.2	7.8	18.0	3.7	18.5	143.5
	March	45.8	19.8	19.6	9.2	8.0	17.9	3.7	18.7	142.9
	June	46.4	19.7	19.7	9.2	7.8	18.0	3.7	18.9	142.9
2003-2004	September	47.6	19.9	20.1	9.4	8.1	18.8	3.6	16.1	144.0
	December	47.8	19.9	20.3	9.3	8.3	18.8	3.6	16.4	144.4
	March	50.4	20.1	20.3	9.3	8.3	18.9	3.6	16.8	147.9
	June	49.3	20.0	20.5	9.4	8.0	18.7	3.6	16.6	145.6
2004-2005	September	49.4	20.3	20.6	9.5	7.8	19.0	3.6	22.0	152.8
	December	49.1	20.5	20.4	9.7	7.9	19.0	3.6	22.3	152.5
	March	49.0	20.6	20.2	9.7	8.0	18.9	3.6	22.2	152.3
	June	49.3	20.6	21.0	9.7	8.2	18.9	3.6	22.2	152.9
2005-2006	September	49.4	20.2	20.4	9.8	8.0	18.7	3.5	21.2	151.6
	December	49.9	20.1	21.2	9.9	7.9	18.6	3.5	21.4	152.5
	March	50.7	20.2	21.1	10.0	7.9	18.5	3.5	21.2	153.1
	June	51.5	20.7	20.9	10.2	8.1	18.5	3.5	20.9	154.2

[19] This table presents estimates of quarterly emissions by sector since 2001-02, in seasonally adjusted terms. Estimates for the national inventory total and the electricity sector include weather normalisation, as described in Section 5: Technical Notes. Seasonally adjusted estimates for all other sectors are presented without weather normalisation. As a result, the national inventory total may differ from the sum of the rows.

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions					
2006-2007	September	50.6	20.0	21.0	10.3	8.3	17.8	3.6	23.8	155.6
	December	51.8	20.6	21.3	10.3	8.5	17.7	3.6	23.7	157.7
	March	51.5	20.6	21.7	10.6	8.6	17.6	3.6	23.3	157.4
	June	50.2	20.7	21.8	10.7	8.8	17.5	3.6	22.8	156.3
2007-2008	September	52.0	20.8	21.5	11.1	8.5	17.1	3.7	20.2	155.0
	December	51.3	20.9	21.6	10.0	8.5	17.0	3.7	19.9	152.9
	March	51.4	21.3	21.9	10.8	8.7	17.1	3.8	19.6	154.2
	June	51.3	21.5	22.0	10.3	8.8	16.9	3.7	18.6	153.5
2008-2009	September	53.9	21.5	21.9	10.1	9.1	17.2	3.7	18.4	155.6
	December	53.5	21.2	21.9	10.8	8.6	17.1	3.7	17.8	154.5
	March	52.0	20.3	21.8	10.4	7.4	17.1	3.7	17.1	149.5
	June	52.2	20.6	21.7	10.9	7.7	17.1	3.7	16.2	150.7
2009-2010	September	50.1	20.2	22.3	10.7	8.4	16.6	3.8	13.3	145.1
	December	52.5	20.8	22.2	10.3	8.8	16.6	3.8	12.5	147.7
	March	51.9	21.5	22.1	10.9	9.3	16.5	3.8	11.8	147.4
	June	50.4	21.4	22.3	10.5	9.2	16.6	3.8	10.9	145.6
2010-2011	September	50.1	21.3	22.7	11.0	8.9	17.7	3.7	8.6	143.4
	December	48.2	21.2	23.0	10.7	9.1	17.7	3.7	7.7	141.5
	March	49.9	21.1	22.8	9.8	9.1	17.7	3.6	7.0	140.8
	June	50.0	21.7	22.9	10.0	9.1	17.7	3.6	6.2	141.8
2011-2012	September	50.3	22.4	22.4	10.3	9.0	18.0	3.3	5.6	140.8
	December	50.3	22.3	22.2	10.4	8.1	18.0	3.3	4.8	139.5
	March	49.5	22.5	23.8	10.5	8.3	18.1	3.3	4.2	139.8
	June	48.8	22.2	23.6	10.8	8.1	18.0	3.2	3.5	138.6

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions					
2012-2013	September	46.7	23.4	23.1	10.5	7.8	18.0	3.1	2.8	135.0
	December	47.0	23.5	23.2	10.6	7.9	18.0	3.1	2.1	135.7
	March	46.6	23.3	22.9	10.5	7.9	18.0	3.1	1.5	133.5
	June	46.7	23.2	23.0	10.4	7.9	18.0	3.1	1.0	133.8
2013-2014	September	44.8	23.2	23.3	9.9	7.8	18.2	3.2	2.9	132.8
	December	45.0	23.5	23.2	10.3	7.8	18.2	3.1	2.3	133.7
	March	46.2	23.5	23.4	10.8	7.8	18.1	3.1	1.7	134.4
	June	44.8	23.7	23.4	10.0	7.8	18.1	3.1	1.3	132.5
2014-2015	September	47.2	22.7	23.8	11.9	8.2	17.6	3.0	-0.2	134.0
	December	47.4	22.6	23.8	11.1	8.2	17.5	3.0	-0.7	133.1
	March	46.9	22.7	23.9	11.1	8.2	17.5	3.0	-1.1	131.9
	June	47.5	22.6	23.8	11.4	8.3	17.4	3.0	-1.5	132.7
2015-2016	September	48.9	22.8	23.9	12.0	8.3	17.4	3.1	-3.5	132.7
	December	49.1	23.0	23.9	11.9	8.3	17.3	3.1	-3.9	132.8
	March	48.8	23.2	24.6	12.8	8.2	17.5	3.1	-4.3	133.7
	June	47.9	23.2	24.0	12.1	8.2	17.1	3.1	-4.6	131.2
2016-2017	September	48.2	23.6	24.3	12.4	8.4	18.4	3.0	-4.4	133.9
	December	46.3	23.8	25.2	12.5	8.4	18.3	3.0	-4.7	133.1
	March	48.3	23.5	24.5	13.1	8.4	18.2	2.9	-5.1	133.7
	June	46.4	24.3	24.7	13.8	8.5	18.1	2.9	-5.3	133.4
2017-2018	September	45.3	24.4	24.9	14.1	8.4	17.8	3.0	-4.5	133.6
	December	45.4	24.7	24.9	14.4	8.5	17.6	3.0	-4.7	134.0
	March	45.1	25.2	25.4	14.1	8.8	17.6	3.0	-5.1	133.9
	June	45.6	25.6	25.8	14.2	8.8	17.5	3.0	-5.2	135.1

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions					
2018-2019	September	44.3	25.9	25.2	14.2	8.5	17.2	3.0	-4.5	134.1
	December	43.9	26.0	25.3	15.6	8.6	17.1	3.0	-4.6	135.2
	March	-	-	-	-	-	-	-	-	-
	June	-	-	-	-	-	-	-	-	-

Data Table 1C: Trend emissions (Mt), by sector, by quarter, since 2001-02[20]

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions					
2001-2002	September	46.0	19.0	18.8	9.8	7.1	19.3	4.0	16.8	140.8
	December	45.7	19.1	18.8	9.7	7.1	19.4	4.0	16.2	140.0
	March	45.9	19.2	19.0	9.6	7.1	19.3	4.0	16.4	140.5
	June	46.6	19.3	19.1	9.5	7.3	18.9	3.9	17.2	141.8
2002-2003	September	47.1	19.4	19.3	9.4	7.6	18.4	3.8	17.9	142.9
	December	46.8	19.6	19.5	9.3	7.8	18.0	3.7	18.7	143.2
	March	46.4	19.7	19.6	9.2	7.9	17.9	3.7	18.8	143.1
	June	46.4	19.8	19.8	9.3	8.0	18.2	3.7	18.0	143.0
2003-2004	September	47.3	19.9	20.0	9.3	8.1	18.6	3.7	17.0	143.9
	December	48.5	19.9	20.2	9.3	8.2	18.8	3.6	16.1	144.9
	March	49.4	20.0	20.4	9.3	8.2	18.9	3.6	16.5	146.3
	June	49.7	20.1	20.5	9.4	8.0	18.9	3.6	18.3	148.4
2004-2005	September	49.4	20.3	20.5	9.6	7.9	18.9	3.6	20.5	150.8
	December	49.1	20.5	20.4	9.7	7.9	19.0	3.6	22.2	152.5
	March	49.1	20.6	20.5	9.7	8.0	19.0	3.6	22.5	152.9
	June	49.2	20.5	20.6	9.8	8.1	18.8	3.6	21.9	152.3
2005-2006	September	49.4	20.2	20.8	9.8	8.0	18.7	3.6	21.6	152.2
	December	50.0	20.2	20.9	9.9	7.9	18.7	3.5	21.1	152.4
	March	50.6	20.3	21.0	10.0	8.0	18.5	3.5	21.1	153.1
	June	51.0	20.4	21.0	10.2	8.1	18.3	3.6	21.9	154.4

[20] This table presents estimates of quarterly emissions by sector since 2001-02, in trend terms. Estimates for the national inventory total and the electricity sector include weather normalisation, as described in Section 5: Technical Notes.' Trend estimates for all other sectors are presented without weather normalisation. As a result, the national inventory total may differ from the sum of the rows.

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions					
2006-2007	September	51.3	20.4	21.1	10.3	8.3	18.0	3.6	22.9	155.9
	December	51.3	20.5	21.4	10.4	8.5	17.7	3.6	23.8	157.1
	March	51.2	20.6	21.6	10.6	8.7	17.6	3.6	23.5	157.4
	June	51.2	20.7	21.7	10.7	8.6	17.4	3.7	22.2	156.3
2007-2008	September	51.2	20.8	21.6	10.7	8.6	17.2	3.7	20.9	154.8
	December	51.3	21.0	21.6	10.6	8.5	17.1	3.7	19.9	153.7
	March	51.4	21.2	21.8	10.4	8.7	17.0	3.8	19.3	153.6
	June	52.1	21.5	22.0	10.3	8.9	17.1	3.7	18.9	154.5
2008-2009	September	53.0	21.4	22.0	10.4	8.8	17.1	3.7	18.3	154.7
	December	53.3	21.0	21.8	10.4	8.3	17.2	3.7	17.9	153.7
	March	52.5	20.6	21.8	10.7	7.8	17.1	3.7	17.1	151.3
	June	51.5	20.3	21.9	10.7	7.7	16.9	3.7	15.6	148.6
2009-2010	September	51.4	20.5	22.1	10.6	8.2	16.7	3.8	14.0	147.3
	December	51.6	20.9	22.1	10.6	8.9	16.5	3.8	12.6	147.0
	March	51.6	21.3	22.2	10.6	9.1	16.5	3.8	11.6	146.7
	June	50.8	21.4	22.3	10.8	9.2	16.9	3.7	10.5	145.7
2010-2011	September	49.6	21.3	22.6	10.8	9.1	17.4	3.7	9.0	143.4
	December	49.2	21.1	22.9	10.5	9.1	17.7	3.7	7.7	141.8
	March	49.4	21.3	22.9	10.1	9.1	17.7	3.6	6.9	141.2
	June	50.0	21.7	22.7	10.0	9.1	17.8	3.5	6.3	141.1
2011-2012	September	50.4	22.2	22.5	10.1	8.8	17.9	3.4	5.6	140.7
	December	50.2	22.3	22.8	10.4	8.4	18.0	3.3	4.9	140.2
	March	49.5	22.4	23.2	10.6	8.1	18.0	3.2	4.2	139.3
	June	48.4	22.6	23.5	10.6	8.0	18.0	3.2	3.5	138.0

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions					
2012-2013	September	47.3	23.1	23.4	10.6	7.9	18.0	3.1	2.8	136.3
	December	46.9	23.4	23.0	10.6	7.9	18.0	3.1	2.0	134.8
	March	46.6	23.4	23.0	10.5	7.9	18.0	3.1	1.5	133.9
	June	46.1	23.3	23.0	10.3	7.9	18.1	3.1	1.7	133.4
2013-2014	September	45.5	23.3	23.2	10.2	7.8	18.1	3.1	2.1	133.3
	December	45.2	23.5	23.3	10.2	7.8	18.2	3.1	2.4	133.5
	March	45.3	23.6	23.4	10.4	7.8	18.1	3.1	1.9	133.6
	June	46.0	23.4	23.5	10.8	7.9	18.0	3.1	1.0	133.6
2014-2015	September	46.6	23.0	23.7	11.1	8.1	17.7	3.0	0.1	133.3
	December	47.0	22.7	23.8	11.2	8.2	17.5	3.0	-0.6	132.9
	March	47.4	22.6	23.9	11.3	8.2	17.5	3.0	-1.2	132.6
	June	47.8	22.7	23.8	11.4	8.2	17.4	3.0	-2.0	132.4
2015-2016	September	48.6	22.8	23.9	11.8	8.3	17.4	3.1	-3.0	132.8
	December	49.0	23.0	24.1	12.2	8.2	17.3	3.1	-3.9	132.9
	March	48.8	23.2	24.2	12.4	8.2	17.3	3.1	-4.4	132.8
	June	48.2	23.4	24.3	12.4	8.3	17.6	3.1	-4.4	132.7
2016-2017	September	47.7	23.5	24.5	12.4	8.4	18.0	3.0	-4.5	132.9
	December	47.5	23.7	24.7	12.6	8.4	18.3	2.9	-4.8	133.4
	March	47.2	23.9	24.8	13.1	8.4	18.3	2.9	-5.0	133.6
	June	46.5	24.1	24.7	13.7	8.4	18.0	3.0	-5.0	133.5
2017-2018	September	45.8	24.4	24.8	14.1	8.4	17.8	3.0	-4.8	133.6
	December	45.3	24.8	25.1	14.3	8.6	17.7	3.0	-4.8	133.9
	March	45.3	25.2	25.4	14.2	8.7	17.6	3.0	-5.0	134.2
	June	45.1	25.6	25.5	14.2	8.7	17.4	3.0	-5.0	134.4

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions					
2018-2019	September	44.6	25.9	25.4	14.6	8.6	17.3	3.0	-4.8	134.7
	December	44.0	26.1	25.3	15.1	8.5	17.1	3.0	-4.5	134.9
	March	-	-	-	-	-	-	-	-	-
	June	-	-	-	-	-	-	-	-	-

Data Table 1D: Black carbon trend emissions (kt), by sector, by quarter, since 2008-2009

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	LULUCF	Black Carbon Inventory Total
		Fuel combustion	Manufacturing industries and construction[21]	Other sectors	Transport					
2008-2009	September	11.6	1.6	0.0	8.5	0.1	1.0	0.0	84.6	97.3
	December	11.7	1.6	0.0	8.6	0.1	1.0	0.0	84.6	97.4
	March	10.6	1.6	0.0	7.8	0.1	1.0	0.0	82.8	94.6
	June	11.4	1.6	0.0	8.4	0.1	1.0	0.0	83.7	96.3
2009-2010	September	12.2	1.5	0.0	9.3	0.1	0.9	0.0	78.7	91.9
	December	12.7	1.5	0.0	9.7	0.1	0.9	0.0	78.7	92.4
	March	11.6	1.5	0.0	8.8	0.1	0.9	0.0	77.0	89.6
	June	12.6	1.5	0.0	9.6	0.1	0.9	0.0	77.8	91.4
2010-2011	September	12.8	1.5	0.1	9.8	0.1	1.3	0.0	71.9	86.1
	December	13.2	1.5	0.1	10.2	0.1	1.3	0.0	71.9	86.5
	March	12.5	1.5	0.1	9.7	0.1	1.3	0.0	70.3	84.2
	June	13.6	1.5	0.1	10.7	0.1	1.3	0.0	71.1	86.2
2011-2012	September	13.4	1.8	0.1	9.7	0.1	1.3	0.0	63.4	78.3
	December	13.7	1.8	0.1	9.9	0.1	1.3	0.0	63.4	78.6
	March	14.2	1.8	0.1	10.6	0.1	1.3	0.0	62.7	78.3
	June	15.1	1.8	0.1	11.4	0.1	1.3	0.0	62.7	79.3
2012-2013	September	14.6	1.9	0.1	10.8	0.1	1.2	0.0	64.0	79.9
	December	15.2	1.9	0.1	11.4	0.1	1.2	0.0	64.0	80.5
	March	13.7	1.8	0.1	10.1	0.1	1.2	0.0	62.6	77.6
	June	14.8	1.9	0.1	11.0	0.1	1.2	0.0	63.3	79.4

[21] Manufacturing Industries and Construction includes metal manufacturing, mining, chemical production and food processing.

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	LULUCF	Black Carbon Inventory Total
		Fuel combustion	Manufacturing industries and construction[21]	Other sectors	Transport					
2013-2014	September	14.9	1.9	0.1	11.0	0.1	1.2	0.0	67.3	83.5
	December	15.3	1.9	0.1	11.3	0.1	1.2	0.0	67.3	83.8
	March	14.6	1.9	0.1	10.7	0.1	1.1	0.0	65.9	81.6
	June	15.4	1.9	0.1	11.4	0.1	1.1	0.0	66.6	83.2
2014-2015	September	15.3	1.9	0.1	11.5	0.1	1.1	0.0	61.1	77.6
	December	15.6	1.9	0.1	11.8	0.1	1.1	0.0	61.1	77.9
	March	14.8	1.8	0.1	11.1	0.1	1.1	0.0	59.8	75.7
	June	15.4	1.8	0.1	11.7	0.1	1.1	0.0	60.4	77.0
2015-2016	September	15.6	1.9	0.1	11.7	0.1	1.0	0.0	64.6	81.3
	December	15.9	1.9	0.1	12.1	0.1	1.0	0.0	64.6	81.6
	March	15.8	1.8	0.1	12.0	0.1	1.0	0.0	63.9	80.8
	June	16.3	1.8	0.1	12.4	0.1	1.0	0.0	63.9	81.3
2016-2017	September	15.3	1.9	0.1	11.9	0.1	1.6	0.2	63.5	80.7
	December	16.5	1.9	0.1	13.1	0.1	1.6	0.2	63.5	81.9
	March	14.9	1.9	0.1	11.6	0.1	1.6	0.2	62.1	78.9
	June	15.9	1.9	0.1	12.5	0.1	1.6	0.2	62.8	80.6
2017-2018	September	16.0	1.9	0.1	12.6	0.1	1.6	0.2	62.6	80.5
	December	16.3	1.9	0.1	12.9	0.1	1.6	0.2	62.6	80.8
	March	16.5	1.9	0.1	13.1	0.1	1.5	0.2	61.2	79.5
	June	17.6	1.9	0.1	14.1	0.1	1.6	0.2	61.9	81.4
2018-2019	September	17.3	1.9	0.1	13.8	0.1	1.5	0.2	63.2	82.3
	December	17.5	1.9	0.1	14.0	0.1	1.5	0.2	63.2	82.5
	March	-	-	-	-	-	-	-	-	-
	June	-	-	-	-	-	-	-	-	-

Data Table 1E: $PM_{2.5}$ trend emissions (kt), by sector, by quarter since 2008-2009

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	LULUCF	$PM_{2.5}$ Inventory Total
		Fuel combustion	Manufacturing industries and construction[22]	Other sectors	Transport					
2008-2009	September	19.7	2.6	0.1	11.6	0.4	6.1	0.0	221.0	247.2
	December	19.5	2.6	0.1	11.6	0.4	6.1	0.0	221.0	247.0
	March	18.3	2.5	0.1	10.5	0.4	6.0	0.0	216.2	240.8
	June	19.1	2.5	0.1	11.4	0.4	6.0	0.0	218.6	244.1
2009-2010	September	19.4	2.6	0.1	12.5	0.4	5.3	0.0	216.2	241.4
	December	20.1	2.6	0.1	13.2	0.4	5.3	0.0	216.2	242.0
	March	18.8	2.6	0.1	11.9	0.4	5.2	0.0	211.5	235.9
	June	19.8	2.6	0.1	13.0	0.4	5.2	0.0	213.9	239.3
2010-2011	September	20.7	2.5	0.1	13.2	0.5	7.7	0.0	217.0	245.8
	December	20.9	2.5	0.1	13.7	0.5	7.7	0.0	217.0	246.0
	March	20.4	2.5	0.1	13.0	0.4	7.5	0.0	212.3	240.7
	June	21.7	2.5	0.1	14.4	0.4	7.6	0.0	214.6	244.4
2011-2012	September	21.4	2.8	0.1	13.1	0.3	7.7	0.0	202.0	231.4
	December	21.5	2.8	0.1	13.4	0.3	7.7	0.0	202.0	231.5
	March	22.5	2.8	0.1	14.3	0.3	7.6	0.0	199.8	230.2
	June	23.4	2.8	0.1	15.3	0.3	7.6	0.0	199.8	231.1
2012-2013	September	22.5	2.9	0.1	14.6	0.3	7.2	0.0	203.6	233.6
	December	23.1	2.9	0.1	15.3	0.3	7.2	0.0	203.6	234.2
	March	21.5	2.8	0.1	13.6	0.3	7.0	0.0	199.2	228.0
	June	22.5	2.9	0.1	14.7	0.3	7.1	0.0	201.4	231.4

[22] Manufacturing Industries and Construction includes metal manufacturing, mining, chemical production and food processing.

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	LULUCF	$PM_{2.5}$ Inventory Total
		Fuel combustion	Manufacturing industries and construction[22]	Other sectors	Transport					
2013-2014	September	22.6	2.9	0.1	14.8	0.3	6.8	0.0	208.5	238.3
	December	22.9	2.9	0.1	15.2	0.3	6.8	0.0	208.5	238.6
	March	22.4	2.8	0.1	14.4	0.3	6.6	0.0	204.0	233.3
	June	23.1	2.9	0.1	15.3	0.3	6.7	0.0	206.3	236.4
2014-2015	September	23.2	2.8	0.1	15.5	0.4	6.5	0.0	201.8	231.9
	December	23.5	2.8	0.1	15.9	0.4	6.5	0.0	201.8	232.2
	March	22.7	2.8	0.1	15.0	0.3	6.3	0.0	197.4	226.8
	June	23.4	2.8	0.1	15.8	0.4	6.4	0.0	199.6	229.8
2015-2016	September	23.4	2.9	0.1	15.8	0.5	5.9	0.1	186.3	216.1
	December	23.7	2.9	0.1	16.2	0.5	5.9	0.1	186.3	216.5
	March	23.8	2.8	0.1	16.2	0.5	5.9	0.1	184.2	214.4
	June	24.1	2.8	0.1	16.8	0.5	5.9	0.1	184.2	214.8
2016-2017	September	23.0	3.0	0.1	16.0	0.6	9.5	0.5	196.8	230.4
	December	24.3	3.0	0.1	17.6	0.6	9.5	0.5	196.8	231.7
	March	22.6	2.9	0.1	15.6	0.5	9.3	0.5	192.5	225.4
	June	23.6	2.9	0.1	16.8	0.5	9.4	0.5	194.7	228.6
2017-2018	September	23.7	3.0	0.1	16.9	0.6	9.2	0.5	184.1	218.1
	December	24.0	3.0	0.1	17.4	0.6	9.2	0.5	184.1	218.4
	March	24.4	2.9	0.1	17.6	0.6	9.0	0.5	180.1	214.5
	June	25.7	2.9	0.1	19.0	0.6	9.1	0.5	182.1	218.0
2018-2019	September	25.2	3.0	0.1	18.5	0.6	8.9	0.5	180.4	222.8
	December	25.4	3.0	0.1	18.8	0.6	8.9	0.5	180.4	222.9
	March	-	-	-	-	-	-	-	-	-
	June	-	-	-	-	-	-	-	-	-

Data Table 1F: PM_{10} trend emissions (kt), by sector, by quarter, since 2008-2009

Year	Quarter	Energy	Industrial processes and product use	Waste	PM_{10} Inventory Total
2008-2009	September	131.2	2.9	0.1	134.2
	December	131.6	2.9	0.1	134.6
	March	125.4	2.8	0.1	128.2
	June	130.4	2.8	0.1	133.3
2009-2010	September	130.8	2.9	0.1	133.9
	December	131.5	3.0	0.1	134.6
	March	126.5	2.9	0.1	129.5
	June	132.8	2.9	0.1	135.8
2010-2011	September	159.9	3.0	0.1	163.0
	December	158.1	3.0	0.1	161.2
	March	148.2	3.0	0.1	151.2
	June	157.1	3.0	0.1	160.2
2011-2012	September	181.0	2.8	0.0	183.9
	December	184.3	2.8	0.0	187.2
	March	175.8	2.8	0.0	178.6
	June	183.7	2.7	0.0	186.5
2012-2013	September	202.6	3.0	0.1	205.7
	December	205.8	3.0	0.1	208.8
	March	196.3	2.9	0.1	199.2
	June	207.4	3.0	0.1	210.4
2013-2014	September	222.3	3.5	0.1	225.9
	December	223.6	3.5	0.1	227.2
	March	218.9	3.3	0.1	222.4
	June	227.9	3.4	0.1	231.4

Year	Quarter	Energy	Industrial processes and product use	Waste	PM_{10} Inventory Total
2014-2015	September	235.8	3.2	0.4	239.4
	December	235.6	3.2	0.4	239.1
	March	227.3	3.1	0.4	230.7
	June	232.1	3.2	0.4	235.7
2015-2016	September	238.6	3.4	0.3	242.3
	December	237.2	3.4	0.3	240.9
	March	233.0	3.3	0.3	236.6
	June	235.3	3.4	0.3	239.0
2016-2017	September	226.4	3.7	1.1	231.1
	December	227.6	3.5	1.1	232.2
	March	219.7	3.1	1.1	223.9
	June	225.3	3.1	1.1	229.4
2017-2018	September	228.1	3.4	1.1	232.6
	December	227.8	3.5	1.1	232.3
	March	224.2	3.4	1.1	228.6
	June	231.1	3.4	1.1	235.6
2018-2019	September	233.8	3.5	1.1	238.4
	December	233.8	3.5	1.1	238.3
	March	-	-	-	-
	June	-	-	-	-

Data Table 1G: SO_2 trend emissions (kt), by sector, by quarter since 2001-2002

Year	Quarter	Fuel Combustion	Energy Industries	Manufacturing Industries and Construction	Other Sectors	Transport	Industrial processes and product use	SO_2 Inventory Total
2001-2002	September	186.8	154.9	23.7	1.8	6.3	514.7	701.5
	December	178.3	144.3	25.5	1.8	6.7	510.8	689.1
	March	180.1	147.9	24.2	1.8	6.2	503.5	683.5
	June	184.9	152.6	23.8	1.8	6.6	516.5	701.4
2002-2003	September	199.4	168.4	22.7	2.0	6.4	502.6	702.0
	December	192.7	160.0	23.9	2.0	6.8	505.3	698.0
	March	187.8	157.3	22.3	1.9	6.2	494.1	681.9
	June	194.1	160.7	24.7	1.9	6.7	499.1	693.2
2003-2004	September	191.3	158.0	24.6	1.9	6.8	433.9	625.2
	December	184.1	151.1	23.9	1.9	7.2	441.3	625.4
	March	192.7	161.3	22.9	1.9	6.6	436.7	629.4
	June	191.2	158.4	23.7	1.9	7.1	441.4	632.6
2004-2005	September	191.5	157.5	25.1	2.0	6.8	448.7	640.1
	December	183.9	149.0	25.7	2.0	7.2	447.6	631.6
	March	184.8	151.0	25.2	2.0	6.7	433.3	618.2
	June	184.1	151.2	23.7	2.0	7.2	446.4	630.5
2005-2006	September	198.0	164.9	24.5	1.9	6.6	430.2	628.2
	December	192.2	158.7	24.3	1.9	7.2	427.2	619.4
	March	196.6	164.1	24.0	1.9	6.6	415.8	612.4
	June	200.2	164.9	26.4	1.9	7.0	422.4	622.6
2006-2007	September	194.6	161.2	24.2	1.9	7.3	421.9	616.5
	December	192.2	157.1	25.3	1.9	7.9	423.2	615.4
	March	191.7	159.5	23.0	1.9	7.4	415.4	607.0
	June	185.4	152.8	23.0	1.9	7.7	420.5	606.0

Year	Quarter	Fuel Combustion	Energy Industries	Manufacturing Industries and Construction	Other Sectors	Transport	Industrial processes and product use	SO_2 Inventory Total
2007-2008	September	203.1	170.2	24.4	1.9	6.6	431.6	634.8
	December	194.6	159.9	25.7	1.9	7.0	432.3	626.9
	March	198.8	164.3	26.1	1.9	6.6	425.0	623.9
	June	197.0	160.6	27.4	1.9	7.2	429.9	626.9
2008-2009	September	205.7	170.0	26.6	1.9	7.2	459.0	664.7
	December	194.4	160.5	24.8	1.9	7.3	460.3	654.7
	March	191.1	160.8	21.9	1.8	6.6	447.1	638.2
	June	188.6	157.8	21.8	1.8	7.1	453.8	642.4
2009-2010	September	189.9	157.9	23.2	1.9	7.0	406.9	596.8
	December	190.4	157.6	23.6	1.9	7.3	408.5	599.0
	March	193.5	161.4	23.7	1.8	6.6	398.0	591.5
	June	187.4	153.4	25.0	1.9	7.3	405.4	592.8
2010-2011	September	188.6	156.6	23.4	1.9	6.7	447.1	635.7
	December	175.7	144.3	22.5	1.9	7.0	446.5	622.2
	March	184.2	155.4	20.2	1.8	6.7	435.8	620.0
	June	185.4	152.6	23.6	1.8	7.4	444.6	630.0
2011-2012	September	185.4	153.9	23.5	1.9	6.2	453.0	638.4
	December	181.5	148.6	24.6	1.9	6.3	456.1	637.5
	March	182.4	152.1	21.7	1.9	6.7	443.7	626.2
	June	178.3	147.1	22.1	1.9	7.2	438.6	616.9
2012-2013	September	178.0	144.8	25.4	2.0	5.8	435.9	613.9
	December	173.6	141.4	24.2	2.0	6.1	433.5	607.1
	March	175.0	146.4	21.3	1.9	5.4	419.6	594.6
	June	174.0	143.4	22.8	1.9	5.8	424.5	598.5

Year	Quarter	Fuel Combustion	Energy Industries	Manufacturing Industries and Construction	Other Sectors	Transport	Industrial processes and product use	SO_2 Inventory Total
2013-2014	September	170.6	139.5	23.2	2.0	5.9	461.7	632.3
	December	167.7	136.2	23.3	2.0	6.1	461.0	628.7
	March	173.7	146.2	19.8	2.0	5.8	441.6	615.3
	June	168.0	137.9	22.0	2.0	6.1	455.1	623.1
2014-2015	September	167.0	140.8	18.0	2.1	6.1	438.2	605.2
	December	163.5	137.4	17.8	2.1	6.2	430.6	594.1
	March	166.6	142.0	16.6	2.0	5.9	422.1	588.7
	June	165.4	139.7	17.4	2.1	6.2	432.4	597.9
2015-2016	September	163.7	138.4	17.1	2.2	6.0	458.9	622.5
	December	159.8	134.8	16.6	2.2	6.2	456.5	616.4
	March	162.6	140.0	14.2	2.2	6.2	450.6	613.3
	June	158.1	133.2	16.3	2.2	6.4	454.7	612.7
2016-2017	September	164.7	139.2	17.0	2.3	6.1	452.4	617.1
	December	155.3	129.6	16.6	2.3	6.7	432.4	587.7
	March	164.1	141.6	14.3	2.3	6.0	377.7	541.9
	June	156.7	131.5	16.5	2.3	6.4	385.2	541.9
2017-2018	September	157.9	133.2	16.3	2.3	6.0	410.5	568.4
	December	154.3	129.3	16.5	2.3	6.2	416.7	571.0
	March	158.3	134.6	15.2	2.3	6.3	408.6	566.9
	June	157.6	131.4	17.1	2.3	6.7	413.6	571.3
2018-2019	September	157.0	130.1	17.9	2.3	6.6	420.0	577.1
	December	151.6	124.9	17.7	2.3	6.7	417.9	569.6
	March	-	-	-	-	-	-	-
	June	-	-	-	-	-	-	-

Data table 2: Tracking Australia's emissions

The data presented in Table 9 and Figure 25 include Australia's annual emissions for 2000 to 2019.

Australia's annual emissions for the year to December 2018 are estimated to be 538.2 Mt CO_2-e. This figure is 0.4 per cent above emissions in 2000 (536.2 Mt CO_2-e) and 11.9 per cent below emissions in 2005 (610.6 Mt CO_2-e).

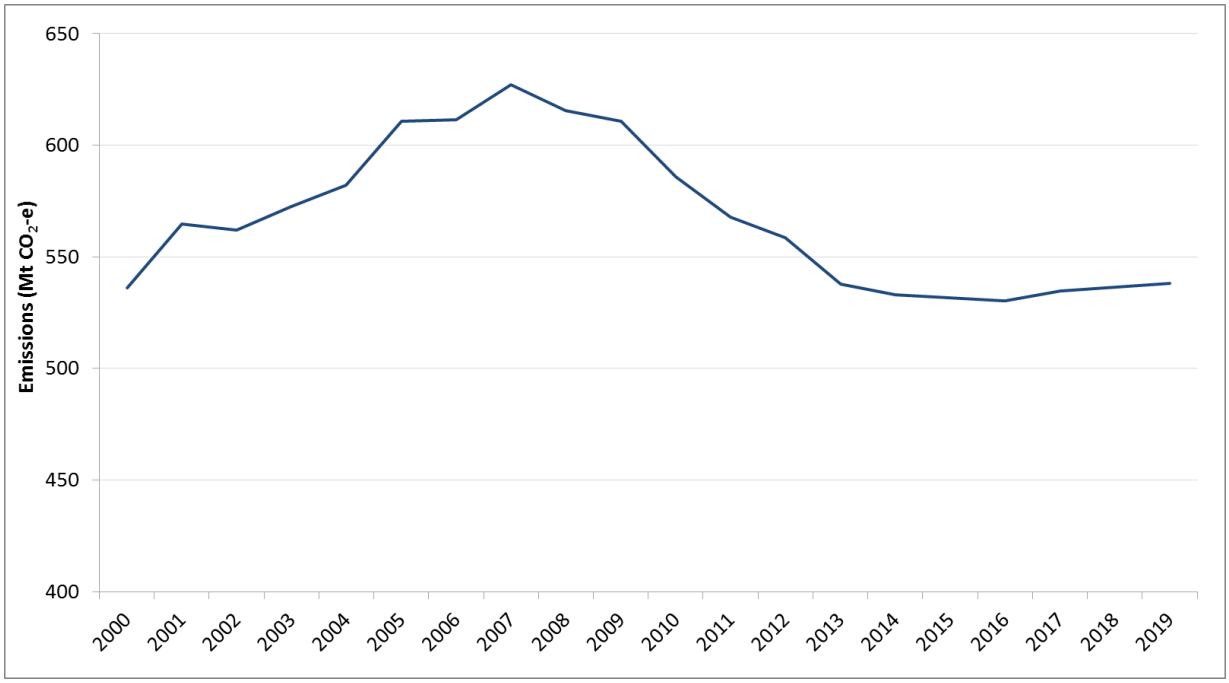
Table 9: National inventory total from 2000 to 2019, by financial year

Financial Year[23]	Emissions (Mt CO_2-e)
2000	536.2
2001	564.8
2002	562.0
2003	572.5
2004	582.0
2005	610.6
2006	611.5
2007	627.0
2008	615.7
2009	610.6
2010	586.0
2011	567.7
2012	558.7
2013	537.7
2014	533.1
2015	531.6
2016	530.4
2017	534.7
2018	536.5
2019[24]	538.2

[23] 2000 to 2017, National Inventory Report 2017 (Department of the Environment and Energy (2019), *National Inventory Report*, Australian Government submission under the UN Framework Convention on Climate Change http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/progress-inventory; 2018,) *Quarterly Update: December 2018*.

[24] Year to December 2018

Figure 25: National inventory total, year to June 2000 to 2019[25]



Source: Department of the Environment and Energy

[25] Year to December 2018

7. Related publications and resources

Australia's National Greenhouse Accounts

The following Department of the Environment and Energy (DoEE) publications are all available on the departmental website:

http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/progress-inventory

National Inventory Report 2017

The three volumes comprising Australia's forthcoming National Inventory Report 2017 were submitted under the UNFCCC and the Kyoto Protocol in May 2019. These reports contains national greenhouse gas emission estimates for the period 1990-2017 and preliminary estimates for 2018 compiled under the rules for reporting applicable to the UNFCCC.

- Volume 1: Includes Australia's data for energy (*stationary energy, transport and fugitive emissions*), *industrial processes and product use*, and *agriculture*.
- Volume 2: Australia's data for the *Land Use, Land Use Change and Forestry* (LULUCF) and *waste* sectors, recalculations and improvements.
- Volume 3: Australia's data for Kyoto Protocol LULUCF, Kyoto Protocol accounting requirements, annexes, glossary and references.

State and Territory Greenhouse Gas Inventories 2017

This document provides an overview of the latest available estimates of annual greenhouse gas emissions for Australia's States and Territories. It complements Australia's *National Inventory Report 2017* and the *National Inventory by Economic Sector 2017*.

National Inventory by Economic Sector 2017

This document provides an overview of the latest available estimates of annual greenhouse gas emissions, disaggregated by Australia-New Zealand Standard Industrial Classifications (ANZSIC). It complements Australia's *National Inventory Report 2017* and the *State and Territory Greenhouse Gas Inventories 2017*.

Australian Greenhouse Emissions Information System (AGEIS)

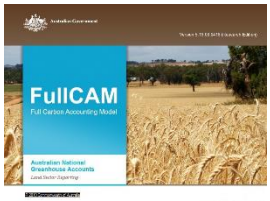
The AGEIS centralises the Department's emissions estimation, emissions data management and reporting systems. AGEIS is being used to compile national and State and Territory inventories. The interactive web interface provides enhanced accessibility and transparency to Australia's greenhouse emissions data: http://www.environment.gov.au/climate-change/climate-science-data/greenhouse-gas-measurement/ageis

Australia's Emissions Projections: 2018

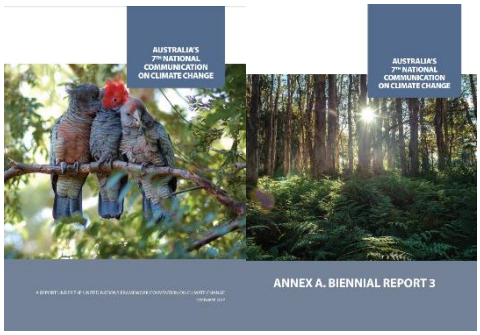
The report provides detail on emissions trends, including sector specific analysis of factors driving emissions. The report estimates the emissions reduction effort required to meet Australia's emissions reduction targets. The projections include sensitivity analyses to illustrate how emissions may differ under changes in economic growth.
http://www.environment.gov.au/climate-change/publications/emissions-projections-2018

Full Carbon Accounting Model

The Full Carbon Accounting Model (FullCAM) is the calculation engine which supports the estimation of carbon stock change on forest and agricultural systems. FullCAM can be downloaded from the Department's webpage: http://www.environment.gov.au/climate-change/climate-science-data/greenhouse-gas-measurement/land-sector



Australia's Seventh National Communication/Third Biennial Report



Australia's Seventh National Communication (2017) summarises information on Australia's implementation of its UNFCCC and Kyoto Protocol obligations including: emissions and removals of greenhouse gases; national circumstances; policies and measures; vulnerability assessment; financial, technology and capacity building cooperation; education, training, and public awareness. Countries such as Australia are required to submit these reports to the UNFCCC every four years. In accordance with international reporting requirements, the 2017 National Communication also incorporates Australia's Third Biennial Report. Biennial Reports must be submitted every two years and outline Australia's progress in achieving emission reductions and the provision of financial, technology, and capacity-building support. More information is available at:
http://unfccc.int/national_reports/annex_i_natcom/submitted_natcom/items/10138.php

What the rest of the world is doing

Other developed countries are also required to produce annual greenhouse gas inventories. More information regarding the reporting requirements and various international reports (including reports by Australia) are located online.
https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/national-inventory-submissions-2019

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